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OIL SHALE TRACT C-b

ENVIRONMENTAL AND EXPLORATION PROGRAM

SUMMARY REPORT #5

(Through November 30, 1975)

C-b SHALE OIL PROJECT

Ashland Oil, Inc.
Shell Oil Company, Operator

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U. S. DEPARTMENT OF THE INTERIOR

PROTOTYPE OIL SHALE LEASING PROGRAM

TRACT C-b

SUMMARY REPORT #5

(Through November 30, 1975)

Submitted to:

Mr. Peter A. Rutledge
Area Oil Shale Supervisor
Conservation Division
U. S. Geological Survey
Grand Junction, Colorado

By:

C-b Shale Oil Project

Ashland Oil, Inc.
Shell Oil Company, Operator

1700 Broadway
Denver, Colorado 80202

February 10, 1976

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SUMMARY REPORT #5
(Through November 30, 1975)

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Summary Report #5 and Quarterly Data Report #5 cover the fifth quarter of exploration and environmental data for the Environmental Baseline Program of Tract C-b. These reports specifically cover the fall quarter of September, 1975 through November, 1975. Quarterly Data Report #5 consists of five volumes of a comprehensive compilation of data submitted to the Area Oil Shale Supervisor in Grand Junction on January 16, 1976. Parties interested in reviewing the comprehensive data may contact the Area Oil Shale Supervisor's Office. This Summary Report#5 is intended to provide the reader with a general overview of the information included in the Quarterly Data Report #5. For a complete summary of on-Tract activities to date, reports from all five quarters must be consulted.

For ready reference, the reader is reminded that both outline and section numbering in Summary and Quarterly Data Reports are identical. Further, the complete data for this quarter are presented in Quarterly Data Report #5 which the reader is referred for an in-depth study.

Being issued at approximately the same time as this report is the Annual Summary and Trends Report which presents a comprehensive summary of the first year of the environmental baseline programs of Tract C-b.

Effective December 31, 1975 Atlantic Richfield Company and The Oil Shale Corporation terminated their participation in the C-b Shale Oil Project. Ashland Oil, Inc. and Shell Oil Company are continuing the project with Shell Oil Company as the Operator. They intend to complete the two-year environmental baseline program and have submitted the Detailed Development Plan in order to proceed with the approval process. Some activities, however, are being postponed pending clarification of a number of problems which stand in the way of oil shale development.

I

PRE-EXPLORATION ENVIRONMENTAL RECONNAISSANCE SURVEYS

No environmental reconnaissance surveys were conducted during this quarter. The results of previous surveys are contained in Quarterly Data Reports #1 and #2 and are summarized in Summary Reports #1 and #2.

ENVIRONMENTAL BASELINE MONITORING PROGRAMS

II A SURFACE WATER

II A-1 Surface Streams

During the fifth quarter, information was obtained on each of the 13 surface water gauging stations shown in Figure II A-1. The data are preliminary and subject to revision and cover the water year ending September 30, 1975. The major gauging stations are designated in Table II A-1. The other stations are on ephemeral streams and data are obtained only during a precipitation event of sufficient magnitude to cause a recordable flow in the channel. At several stations little or no flow was recorded during the 1975 water year. These stations are:

09306015	No flow all year
09306028	Flow three days in December, nine days in March, one day in August
09306033	Flow six days in March, two days in June, three days in July one day in September
09306036	No flow except one day in July
09306039	Flow primarily in the winter months December through March; otherwise little or no flow
09306042	No flow all year
09306050	No flow except one day in January, two days in March
09306052	No flow except one day in January, six days in March

Tables presenting the various information and printouts are presented in Quarterly Data Report #5. Table II A-1 summarizes this information which is grouped by Water Gauging Stations and arranged in the order presented in Table II A-1. Charts showing this yearly data and trends are presented in the final section of the data report.

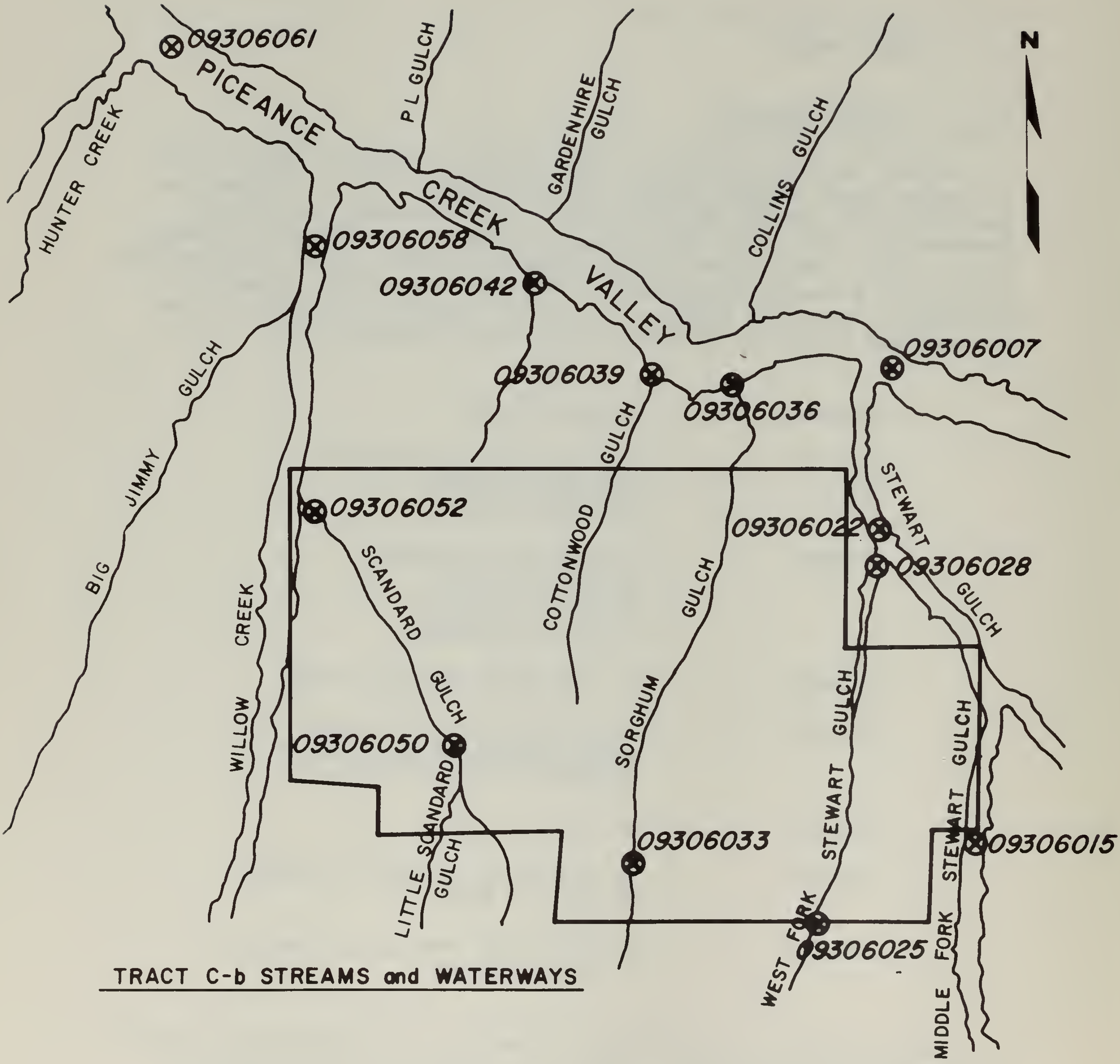


FIGURE II A-1 ⊗ SURFACE WATER GAUGING STATION

TABLE II A-1

SURFACE WATER DATA PRESENTED
QUARTERLY DATA REPORT #5

Station	Daily Gauge Height	Daily Mean Sediment & Discharge	Dissolved Oxygen	pH Readings	Specific Conductance	Temperature	Turbidity Values	Sediment Concentrations	Specific Conductance From PS-69 Samples	Temp, pH, D.O. & Conductivity PS-69 Samples	Water Quality Data Process Date 11-7-75
09306007*	x	x	x	x	x	x	x	x	x	x	x
09306015	x	x									
09306022*	x	x	x	x	x	x			x	x	x
09306025	x	x			x	x			x	x	x
09306028	x	x			x	x					
09306033	x	x									
09306036	x	x									
09306039	x	x							x	x	x
09306042	x	x									
09306050	x	x							x	x	x
09306052	x	x							x	x	x
09306058*	x	x	x	x	x	x			x	x	x
09306061*	x	x	x	x	x	x		x	x	x	x

*major gauging station

Because the surface water monitoring on Tract C-b began in April 1974, some data exist for the last five months of water year 1974 and all of water year 1975. These data are presented in Table II A-2 as monthly averages for May through September for both water years for Piceance Creek stations upstream (007) and downstream (061) from the Tract and the station on the West Fork of Stewart Gulch (025).

In every month of 1975, average flow at the Piceance Creek stations is greater than the corresponding flow in 1974. In all months except August, it is substantially greater. In May and June the percentage increase in discharge at 061 is greater than the percentage increase at 007. From July to September the reverse is true.

II A-2 Springs and Seeps

In September, 1975, samples were obtained from seven springs and analyzed for major constituents, rare metals, total organic carbon and radioactivity. In general the constituent analyses for all these springs are similar and the differences found in the analyses of the samples taken in September 1974 do not show up. The analysis for Spring 3 is consistently different from the analysis of the other springs but not significantly different. Summary analyses of all samples and laboratory data sheets are presented in Quarterly Data Report #5.

TABLE II A-2

MAY-SEPTEMBER AVERAGE MONTHLY DISCHARGE (cfs)

WATER YEARS 1974 AND 1975

SELECTED SURFACE WATER STATIONS

C-b TRACT PICEANCE BASIN

Station	Year	May	June	July	August	September
025	1974	.033	.026	.026	.011	.011
	1975	.022	.035	.022	.017	.014
	% increase (decrease)	(33)	35	(15)	55	27
061	1974	10.80	7.83	8.22	16.32	11.5
	1975	36.66	25	13.37	16.77	17.91
	% increase	239	219	63	3	56
007	1974	16.69	7.65	6.81	11.38	6.28
	1975	46.41	21.92	10.78	14.76	14.8
	% increase	178	187	58	30	136

II B CORE DRILLING AND ASSOCIATED GROUND WATER

Field activity was at a minimum this past quarter. The present drilling program has been completed and fully reported in past quarterly reports. Quarterly Data Report #5 primarily deals with data not received and analyzed in time for presentation in Quarterly Data Report #4 and with the semi-annual groundwater monitoring program.

II B-1 Well Survey Plats

All well survey plats have been reported in previous quarterly reports.

II B-2 Well Completion Data

Four wells, SG-8, SG-10 SG-11 and SG-17, were recompleted this past quarter. The bottom slotted section in the 2 3/8 inch tubing in SG-10 was sealed off with cement and the well plugged back to 1463 feet. The lower perforations in String #2 in SG-17 were sealed off with cast iron bridging plugs set at 1950 feet and 1903 feet and String #2 was plugged back to 1853 feet. SG-11 was plugged to 1928 feet in String #1 with a bridging plug and 50 feet of cement. In SG-8 the tubing and open-hole packer were pulled and the hole was plugged back with cement to 1650 feet. Four and one-half inch casing was landed at 1650 feet and cemented from 949 feet to the surface. The bottom 701 feet of the casing were slotted.

To satisfy the Lease requirement for "lower aquifer monitoring wells" the deep tubing strings in these wells were completely perforated from mine floor to total depth. At a depth of approximately 2000 feet a thin water-bearing lens was encountered. This lens has very poor quality water (TDS 30,000 mg/l) and a hydrostatic gradient greater than the overlying aquifers. Thus low quality water was migrating up the well holes and comingling with water of considerably higher quality. By plugging back in each well this situation has been corrected.

II B-3 Drilling Water Production Data

All drilling water production data have been reported.

II B-4 Water Quality - Drilling

Drilling water quality has been completely reported in previous reports.

II B-5 Water Quality - Baseline Monitoring

A complete year of baseline water quality data is now available for most wells. The wells have been sampled at six-month intervals. Complete tabulations of the data are given in Quarterly Data Report #5. A summary of the data is presented for the alluvial wells, the lower aquifer and the upper aquifer monitoring wells. Within Quarterly Data Report #5 the original data sheets are presented following the respective set of tables, i.e., the original data sheets for the alluvial wells follow Tables II B-1 through II B-4, data sheets for the lower and upper aquifer monitoring wells follow Tables II B-5 through II B-12. The tabulated values in Tables II B-1 through II B-12 of the Data Report are taken consistently from the same sources as follows:

Water Quality Parameters:

Conductance, pH and TDS from The Oil Shale Corporation (TOSCO)
Alkalinity and Hardness from Industrial Laboratories
Radioactivity from Hazen Research Corporation
Organic Carbon from Commercial Testing & Engineering Corporation

Major Constituents:

NH_3, OH, NO_3, PO_4 from Industrial Laboratories
All others from TOSCO

Important Trace Elements:

B, Cr, Fe from Industrial Laboratories
F from TOSCO
All others from Commercial Testing & Engineering Corporation

Minor Trace Elements:

All values from Commercial Testing & Engineering Corporation

Many differences in concentrations and occurrences can be noted. The minor trace elements are those elements which have been observed with significant frequency on the mass spectrographic scans. In general, iodine (I), molybdenum (Mo), strontium (Sr), rubidium (Rb), bromine (Br), titanium (Ti) and scandium (Sc) are observed regularly in all samples. Cesium (Cs) and zirconium (Zr) are observed somewhat less regularly in all sources. Uranium (U), thorium (Th), antimony (Sb), silver (Ag), yttrium (Y), germanium (Ge) and gallium (Ga) occur fairly often in the deep wells but almost never in alluvial wells or in springs. Strontium is the only element of the entire group which regularly appears at levels of 1 ppm or more.

Important trace elements are those elements for which recognized Public Health and EPA standards have been written. Of this group, beryllium (Be), cadmium (Cd), hexavalent chromium (Cr^{+6}) and selenium (Se) are not present in concentrations sufficiently above the minimum detectable levels to make continued monitoring of value. Given the high dissolved-solids levels in all C-b waters, it might be expected that some of the naturally occurring trace elements would exceed public health standards. Aluminum (Al), arsenic (As), cobalt (Co), nickel (Ni), vanadium (V) and zinc (Zn) are found only in concentrations well below their allowable levels of 5, 0.1, 0.05, 0.2, 0.1 and 5 mg/l, respectively. Copper (Cu), lead (Pb) and mercury (Hg) exhibit sporadic magnitudes above the allowable levels of 0.2, 0.05 and 0.002 mg/l, but in no case have the levels been consistently exceeded. Excessive barium (Ba) levels (above 1.0) have been observed only in three wells in the lower aquifer, SG-10, 11 and 17. High boron (B) concentrations (above 1.0 mg/l) are observed regularly in the deep wells and frequently in the alluvial wells and in the springs. Extremely high levels occur in some lower-aquifer wells. Allowable fluoride levels ($F<1.0$ mg/l) are exceeded almost universally by an order of magnitude in deep wells and quite often by small amounts in the alluvial wells and in the springs. Allowable iron (Fe) and manganese (Mn) concentrations are exceeded often in all water sources, but by widely varying margins which are seldom consistent. This indicates that analytical methods may be at fault for these two elements.

To summarize the analytical results for the major trace elements only fluoride is clearly and consistently present at levels much too high for public or agricultural use. Boron, iron and manganese are widely present in concentrations near the maximum allowable level. Barium, copper, lead and mercury exhibit occasional high values and should continue to be monitored. No strong relationships between concentration and depth are seen. Water from the springs appears to resemble more nearly that from the alluvial wells than from the deep wells, the chief difference being the fluoride concentrations. No uniform variation with time appears except for the alluvial wells where values from the spring sampling run appear to be consistently lower than from the fall runs. Mercury is an exception with all the high values being reported in the spring at levels 10 times as high as the fall values; the mercury analyses during the spring sampling run are suspect.

Of the major constituents, hydroxide (OH) never occurs and phosphate (PO_4) almost never occurs above the minimum detectable levels. Lithium is found only in the lower aquifer. Clearcut differences in ionic ratios are seen. Calcium, magnesium, nitrate and sulfate are higher in the springs and alluvial wells than in the deep wells, but the opposite is true for bicarbonate, carbonate, chloride and sodium. Ammonia and potassium are high only in the lower aquifer and silica exhibits little variation.

Larger values of conductance and total dissolved solids (TDS) occur in the lower aquifer. A generally accepted relationship in the Piceance

Basin is that the total dissolved solids in mg/l equates to 0.65 times conductance in micro-mhos. Figure II B-1 presents the data for the upper aquifer, which is in good agreement with the expected correlation. This correlation is not in good agreement in the lower aquifer for the very high levels of TDS and conductance. The pH values are similar for all sources, apparently increasing somewhat with depth. Because of the differences in ionic ratios discussed earlier, water in the springs and in the alluvial wells exhibits a significantly greater hardness than that in the deep wells. Radiation and organic carbon content reach significant levels only in the lower aquifer.

Table II B-1 presents data on parameters monitored while gathering the ground water environmental samples in September and October. Over 130 hours of swabbing time were required to obtain the water samples from the lower and upper aquifer monitoring wells. This does not include the time spent rigging up, rigging down and moving from well to well. The amount of water swabbed prior to sampling varied from four barrels (42 gallons/barrel) at SG-6, String #1 to 860 barrels at SG-17, String #1. Conductivity was measured during swabbing and again when the water sample was analyzed in the laboratory. The conductivity reported in Table II B-1 is the conductivity measured in the field.

In addition to all of the above, data on the retesting of water samples correcting analyses reported in previous quarterly reports and laboratory data from SG-18a, which have not been presented heretofore, are presented in *Quarterly Data Report #5*.

Water quality is discussed at greater length in the *Annual Summary and Trends Report*.

II B-6 Aquifer Data - General

Listed below are the completed wells in which water levels were monitored in the quarter from September to November 1975. Figure II B-2 shows the locations of the wells.

Aquifer Test Wells

- AT-1
- AT-1c Strings 1, 2 and 3

Deep Core Holes and Wells

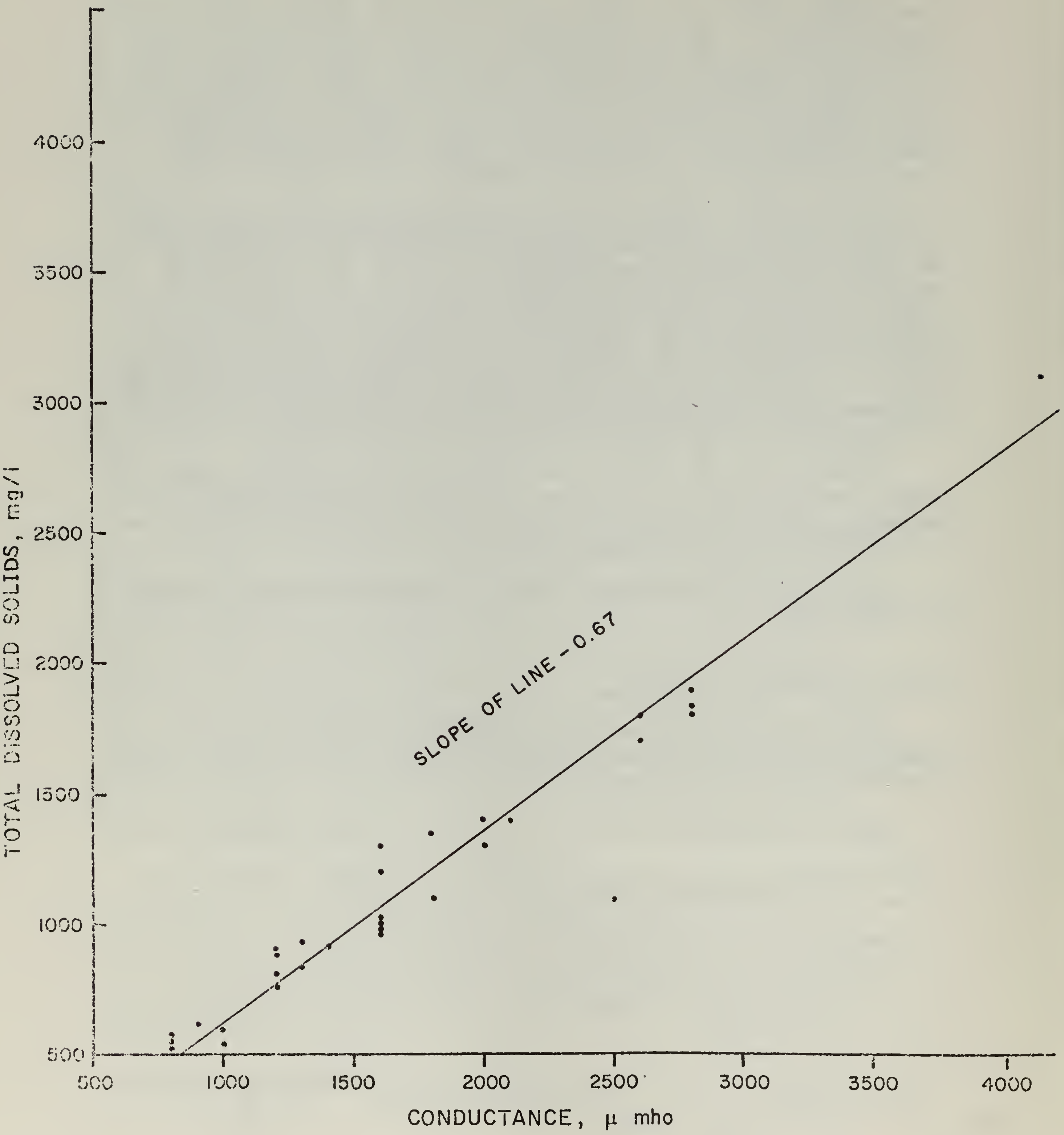
- SG-1 String 1 and 2
- SG-6 String 1, 2 and 3
- SG-8 String 2
- SG-9 String 1 and 2
- SG-10
- SG-10a
- SG-11 String 2 and 3
- SG-17 String 1 and 2
- SG-18a
- SG-21

Alluvial Wells

- A-1
- A-2
- A-3
- A-5
- A-6
- A-7
- A-8
- A-9
- A-10
- A-11
- A-12

Existing Open Core Holes

- Cb-1
- Cb-2
- Cb-3
- Cb-4



TDS - CONDUCTANCE RELATIONSHIP FOR THE UPPER AQUIFER

Figure II B-1

Table II B-1

PARAMETERS MONITORED GROUND WATER SAMPLING PROGRAM

September-October 1975

Well Name and String No.	Length of Time (hrs) Swabbed	Amount of Water Swabbed (bbls)	Range of Conductivity (micromhos)	Final Conductivity Sampled (micromhos)	Water Level Below Ground Level (feet)	Field Temperature
SG-1 St #1	5	53 2/3	3000-6600	3600	62.8	22°C
SG-2 St #2	1 1/2	17 1/2	1250-1450	1300	61.34	19°C
SG-6 St #1	2	4	3000-3300	3150	397.34	14°C
SG-6 St #2	1 1/2	6 1/3	1650-1300	1350	380.42	15°C
SG-6 St #3	1 1/2	8 1/2	1450-1750	1700	330.78	15°C
AT-1	6 1/2	30	1225-1425	1250	399.75	21.5°C
SG-8 St #2	3	40	1650-2200	2100	87.8	15°C
SG-9 St #1	10	99 3/4	1700-12,000	1950	360.96	24°C
SG-9 St #2	2	12 1/3	1650-2000	1950	471.21	18.5°C
SG-10	1 3/4	12 2/3	55,000-60,000	No Sample Taken	471.21	19°C
SG-10a	3	72 1/2	1300-1500	1400	380.80	17°C
SG-11 St #1	5	55	38,000-50,000	38,000		23°C
SG-11 St #2	2	9	1250-1300	1300	367.08	15°C
SG-11 St #3	3 1/2	7 2/3	1750-2200	2100	351.96	14.5°C
SG-17 St #1	55	859 3/4	55,000-13,500	13,500		26°C
SG-17 St #2	4	55 1/3	1400-2275	2000	395.87	17°C
SG-18a	3	46	800-1050	900	489.55	19.5°C
SG-19		55 gpm flow		2800	Flowing	
SG-20		70 gpm flow		2900	Flowing	
SG-21	3	71 1/2	800-1075	950	109.67	16°C
AT-1c St #1	3	8 2/3	1300-1750	1300	393.10	15°C
AT-1c St #2	3	12	1200-1400	1375	392.19	17°C
AT-1c St #3	2 1/2	25 2/3	1400-1600	1450	357.55	18°C
Cb-1	5 1/2	67	3375-5250	3600	359.37	20°C
Cb-2	3	28	1600-1750	1650	331.1	13.5°C
Cb-4	3	18 1/2	800-950	900	431.60	14.5°C

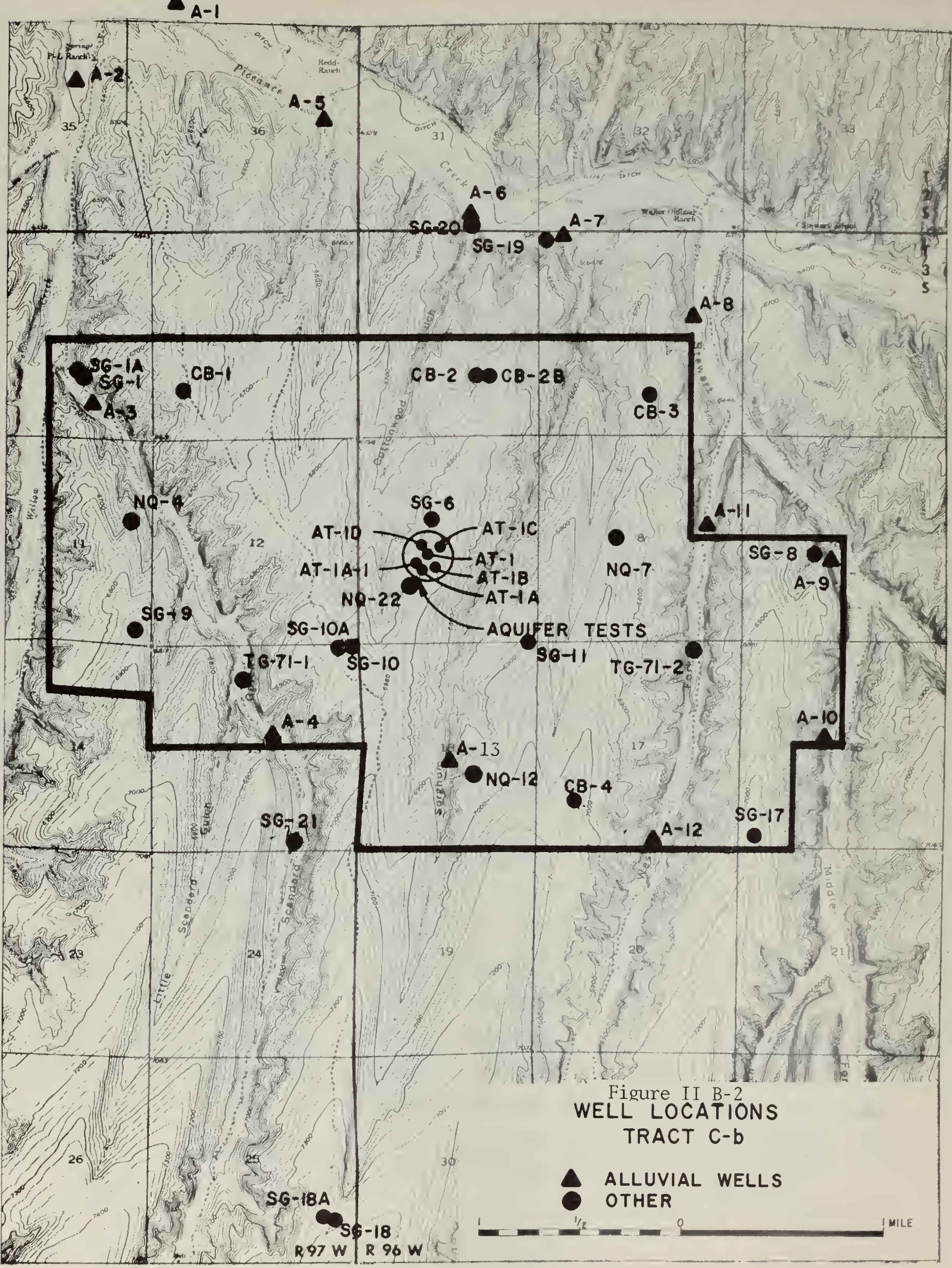


Figure II B-2
WELL LOCATIONS
TRACT C-b

Table II B-2 gives the summary of reduced water levels and the months of observations. Updated plots of water level elevations in each well are presented in the Annual Data Section in Quarterly Data Report #5. These plots indicate that the fluctuations of water levels in the upper and lower aquifers occur independently. The water level is seen to rise in the northeastern sector of the lower aquifer during the quarter and the levels are seen to fall during the same period in the upper aquifer. These data add support to the hypothesis that the upper and lower aquifers are not hydraulically connected. Both the upper and lower aquifers are composed of fractured sedimentary rocks. Water levels in observation wells located in jointed rocks can vary over short distances by many feet because of the existance of more than one system of energy potential within the fractured medium. A complete summary to the water level data and trends is presented in the Annual Summary and Trends Report.

II B-7 Aquifer Data - Pump Test

During October, 1975, pump tests in 11 of the 13 alluvial wells were conducted to determine the hydraulic parameters of the aquifer. Two wells, A-4 and A-13, are dry. The locations of the 13 wells are shown in Figure II B-2. In the pump tests, the test well was also used as the observation well. The recovery method was adopted to evaluate the hydraulic conductivity. Draw-down data were also collected to evaluate the aquifer properties by Glover's type-curve method.

The recovery method to determine the aquifer properties was described in Quarterly Data Report #1. The solution developed is accurate for confined aquifers when the draw-down is small compared to aquifer thickness. In confined aquifers, the entire saturated thickness does not contribute flow. The formula developed in Quarterly Data Report #1 could still be used for unconfined aquifers after applying a correction to the observed draw-downs. A formula for the correction factor is developed below. This factor was applied to the observed draw-down in determining the aquifer properties.

The steady discharge, Q, from a fully penetrating well in an unconfined aquifer is given by

$$Q = \pi K \frac{h_2^2 - h_1^2}{\ln\left(\frac{r_2}{r_1}\right)} \quad \text{--------------------------(1)}$$

where K is the hydraulic conductivity of the aquifer

h_1 and h_2 are the hydraulic heads at distances

r_1 and r_2 from the center of the well

See Figure II B-3

TABLE II B-2

SUMMARY OF WATER LEVELS
(Reduced Levels in Feet)

TIME	WELL IDENTIFICATION											
	AT-1	AT-1c #1	AT-1c #2	AT-1c #3	A-1	A-2	A-3	A-5	A-6	A-7	A-8	A-9
1975 Sept.	-	6510.07	6511.00	6548.06	6236.70	6270.61	6373.49	6325.83	6327.06	6350.26	6383.59	6491.56
Oct.	-	6512.90	6513.81	6548.45	6235.51	6272.25	6372.26	6325.79	6325.10	6351.40	6384.46	6492.18
Nov.	6516.05	6515.65	6516.50	6549.00	6235.26	6273.81	6371.42	6325.90	6327.05	6348.26	6380.05	6492.01
	A-10	A-11	A-12	SG-1 #1	SG-1 #2	SG-6 #1	SG-6 #2	SG-6 #3	SG-8 #2	SG-9 #1	SG-9 #2	SG-10
1975 Sept.	6567.39	6448.82	6636.74	6365.14	6367.50	6489.00	6505.30	6558.60	-	6509.24	6520.15	6483.99
Oct.	6567.09	6448.85	6637.52	6366.02	6367.21	6491.01	6507.93	6557.57	6450.91	6509.44	6517.84	6480.02
Nov.	6565.48	6448.75	6636.47	6362.67	6366.81	6492.52	6510.38	6559.05	6451.59	6508.51	6516.50	6480.63
	SG-10a	SG-11 #2	SG-11 #3	SG-17 #1	SG-17 #2	SG-18a	SG-21	Cb-1	Cb-2	Cb-3	Cb-4	
1975 Sept.	6573.53	-	6531.70	-	6638.50	6900.04	6702.98	6403.67	6415.83	6413.08	6626.45	
Oct.	6572.73	6532.92	6548.37	-	6640.13	6896.69	6703.63	6404.01	6405.79	6412.75	6625.70	
Nov.	6574.00	6534.86	6547.58	6625.58	6640.52	6896.02	6703.85	6404.08	6406.90	6413.20	6625.74	

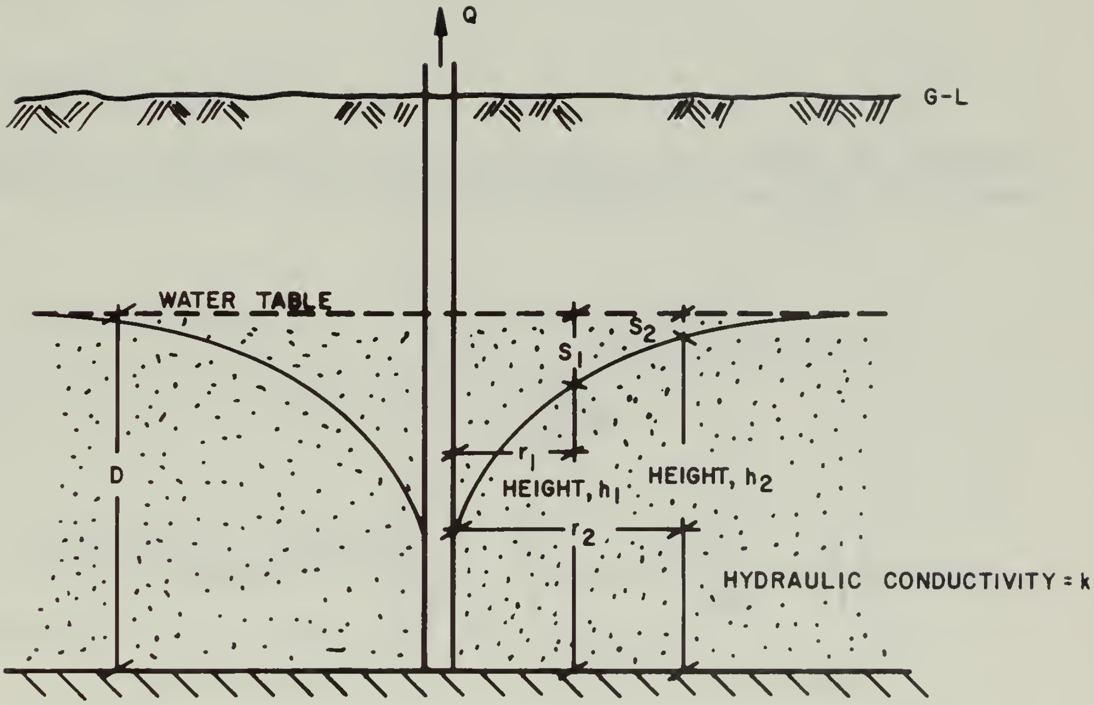


Figure II B-3

PUMP TEST SCHEMATIC

Equation (1) can be written

$$Q = \pi K \left[\frac{(D-s_2)^2 - (D-s_1)^2}{\ln\left(\frac{r_2}{r_1}\right)} \right] \text{-------------(2)}$$

where D is the saturated thickness of aquifer

s_1 and s_2 are the draw-down at distances of

r_1 and r_2 from the center of the well

Expanding the numerator in equation (2) and multiplying the resulting equation by $\left(\frac{2D}{2D}\right)$ and simplifying, yields:

$$Q = 2\pi KD \left[\frac{\left(s_1 - \frac{s_1^2}{2D}\right) - \left(s_2 - \frac{s_2^2}{2D}\right)}{\ln\left(\frac{r_2}{r_1}\right)} \right] \text{----------------------- (3)}$$

Designating $\left(s_1 - \frac{s_1^2}{2D}\right) = s_1'$ and $\left(s_2 - \frac{s_2^2}{2D}\right) = s_2'$, equation (3)

reduces to

$$Q = 2\pi T \frac{(s_1' - s_2')}{\ln\left(\frac{r_2}{r_1}\right)} \text{-------------------------------------(4)}$$

where T = KD

Equation (4) may be recognized as the steady state equation for a confined aquifer.

Results of Pump Tests

The aquifer parameters were calculated by the recovery method and also by the type curve method. Table II B-3 summarizes the aquifer parameters determined from the pump-test plots which are in Quarterly Data Report #5. Approximate calculations were made for maximum pumpage and for the time required to reach maximum draw-down at this discharge. These values are valid only for infinite aquifers and under other assumptions used in the development of the flow equations. However, they give useful "quick-look" approximations.

II B-8 Lithologic Log Data

There are no data to report for this section.

II B-9 Geophysical Data

There are no data to report for this section.

II B-10 Core-Assay Data

There are no data to report for this section.

II B-11 Trace Elements Analysis

There are no data to report for this section.

II B-12 Rock Mechanics

There are no data to report for this section.

II B-13 Gas Sampling Program

Since Quarterly Data Report #4 was published, data collection for the Gas Sampling Program has yielded additional information concerning gas associated with ground water on Tract C-b. Quarterly Data Report #4 also discussed gas sampling from the inclined coreholes. Further analyses of these tests are described below.

TABLE II B-3
AQUIFER PARAMETERS FROM ALLUVIAL PUMP TEST

Well No.	Aquifer (Saturated) Thickness (Ft.)	Hydraulic Conductivity (Ft./day)	Transmissivity		Intrinsic Permeability (Darcy)	Specific Yield	Maximum Pumpage (gpm)	Time Required to Reach Maximum Drawdown at Maximum Pumpage (Days)
			gals/day/ft	ft^2/day				
A-1	65.04	21.50	10,481	1400	8.95	0.157	145	3758
A-2	72.70	3.44	1,872	250	1.41	0.114	30	6015
A-3	37.36	85.40	23,868	3191	35.00	0.140	168	17116
A-5	67.53	79.43	40,126	5364	32.50	0.190	583	1090
A-6	26.70	30.10	6,011	804	12.50	0.095	27	6.6×10^5
A-7	18.00	70.50	6,064	811	28.80	0.118	23	2492
A-8	47.10	23.35	8,234	1100	9.60	0.123	78	12706
A-9	9.94	12.17	906	121	4.98	Not found	--	--
A-10	23.80	421.40	75,019	10029	172.70	0.134	280	2.6×10^5
A-11	12.74	29.76	2,838	379	12.2	Not found	--	--
A-12	28.09	260.00	54,663	7308	106.6	0.153	258	8.6×10^4

Gas-Water Separator Data

The gas-water separator which has been used in the aquifer tests was used to gather further gas-water data during the swabbing of wells SG-11 and SG-17 and during a short pumping test of SG-8.

String #1 at SG-11 was perforated over intervals corresponding to 200 feet below to 1050 feet below the proposed mine floor. String #1 in well SG-17 was perforated over intervals from about the middle of the mine zone down to 950 feet below the proposed mine floor. SG-8 had been completed prior to the pump test and opened from the top of the proposed mine zone to about 950 feet below the proposed mine floor (949' - 1950'). The completion diagrams for wells SG-11 and SG-17 have been included in previous quarterly reports. These wells have been recompleted since the gas-water data were collected. The new completion diagrams are included in _Quarterly Data Report #5_.

For SG-11 the average gas/water ratio, based on the gas and water totals obtained from swabbing, was 5.89 cu ft/1000 gal over a range of 4.26 to 7.29 cu ft/1000 gal. The average gas/water ratio for SG-17, based on totals obtained from swabbing, was 5.86 cu ft/1000 gal over a range of 3.24 to 13.84 cu ft/1000 gal. For the short pump test on the recompleted configuration on SG-8 the average gas/water ratio, based on totals, was 64.8 cu ft/1000 gal with a range from 47.1 to 80.0 cu ft/1000 gal. The data are presented in Tables II B-4 through II B-6.

The cumulative total of these values, including those of SG-8, represents only a small fraction of the proposed ventilation requirements based on currently projected mine water inflow. A possible explanation for the higher values at SG-8 is that it is near Piceance Creek and the structural axis of the syncline. The Baroid gas detector recorded higher values during drilling of SG-8 than during the drilling of any of the other holes on Tract. For this reason any future gas sampling programs might be focused on SG-8 as a worst case. The two and one-half hour pump test on SG-8 must certainly not be considered comprehensive or conclusive.

The values obtained for SG-11 and SG-17 agree well with previous data from the aquifer tests. All of the values are considered to be of the same order of magnitude. Locating gas zones is not possible because of the large intervals which are open in these wells.

Sampling From Cores

The method described in _Quarterly Data Report #3_ under the heading "Sampling From Cores" was used in the inclined core holes at Tract C-b. For details of the method please refer to _Quarterly Data Report #3_, Subsection II B-15.

TABLE II B-4
GAS-WATER SEPARATOR DATA
SWABBING OF SG-17, ST #1, 9-26 to 10-2-75

Date	Time	Water Temp (°F)	Water Vol(Gal)	Gas Vol (Cu Ft)	% Methane	Gas Ratio (Cu Ft/ 1000 Gal)
9-26-75	15:30	-	138	0.875	-	6.34
	15:45	-	55	0.300	-	5.45
	15:50	-	28	0.387	35	13.84
	15:55	-	37	0.425	45	11.49
	16:02	-	0	1.600	50	-
	16:15	-	138	0.788	50	5.71
	16:25	-	41	0.325	50	7.93
	16:32	62	28	0.200	-	7.14
	16:45	62	165	0.900	60	5.45
	16:55	66	83	0.613	55	7.38
	17:00	68	69	0.500	-	7.25
	17:06	68	69	0.425	55	6.16
	17:15	66	73	0.525	58	7.19
	17:20	66	55	0.450	54	8.18
9-27-75	07:30	54	193	1.038	55	5.38
	07:40	60	83	0.413	55	4.97
	08:02	58	179	0.988	55	5.52
	08:10	68	69	0.475	50	6.88
	08:35	67	165*	-	55	-
	09:00	64	165	0.875	55	5.30
	09:25	66	138	0.750	-	5.43
	09:50	66	110	0.713	55	6.48
	10:15	65	124	0.813	52	6.55
	10:30	69	193	1.113	-	5.76
	10:50	71	220	1.175	50	5.34
	11:10	72	165	1.175	50	7.12
	11:35	70	179	1.038	54	5.80
	11:55	68	165	1.175	54	7.12
	12:50	66	138	0.963	48	6.97
	13:15	66	138	1.050	50	7.61
10-2-75	13:49	70	193*	-	-	-
	14:45	72	165	1.150	40	6.97
	14:50	72	165	0.600	40	3.64
	15:10	70	138	0.825	40	5.98
	15:25	72	165	1.425	42	8.64
	15:32	70	193	0.750	46	3.89
	15:40	74	165	0.688	46	4.17
	15:45	70	165	0.663	46	4.02
	15:50	72	193	0.675	45	3.50
	15:55	72	165	0.550	45	3.33
	16:00	74	193	0.625	50	3.24
	16:05	74	165	0.600	48	3.64
	16:10	74	165	0.700	52	4.24
	16:15	74	165	0.550	50	3.33
Total			5440	31.868	Avg. =	5.86

* Missed gas readings; these values neglected in totals

TABLE II B-5
GAS-WATER SEPARATOR DATA
SWABBING OF SG-11, ST #1, 10-8 to 10-9-75

Date	Time	Water Temp (^{O}F)	Water Vol(Gal)	Gas Vol(Cu Ft)	% Methane	Gas Ratio (Cu Ft/ 1000 Gal)
10-8-75	15:45	62	165	1.113	-	6.75
	15:50	64	138	0.588	45	4.26
	16:00	63	110	0.575	50	5.23
	16:10	62	83	0.575	55	6.93
	16:25	63	83	0.550	60	6.63
10-9-75	09:30	-	248*	-	-	-
	09:45	56	110	0.750	-	6.82
	09:55	59	83	0.525	55	6.33
	10:05	60	69	0.425	55	6.16
	10:15	53	55	0.350	-	6.36
	10:30	62	96	0.700	55	7.29
	10:50	64	124	0.675	-	5.44
	11:00	66	69	0.450	60	6.52
	11:10	64	69	0.450	60	6.52
	11:20	65	55	0.275	55	5.00
	11:35	68	151	0.725	60	4.80
	11:45	68	69	0.375	55	5.43
	11:55	68	69	0.450	50	6.52
	13:00	66	220	1.050	40	4.77
	13:10	64	83	0.600	55	7.23
Total			1901	11.201	Avg. =	5.89

* Missed gas readings; this water quantity neglected in totals.

TABLE II B- 6
GAS-WATER SEPARATOR DATA
PUMPING OF SG-8, 12-24-75

Date	Time	Water Temp (°F)	Gas Temp (°F)	Water Produced (Gal)	Gas Reading (Cu Ft)	Gas Produced (Cu Ft)	% Methane	Gas Ratio (Cu Ft/1000 Gal)
12-24-75	10:10	-	40	0	0	0	20	-
	10:25	54	38	191	9.0	9.0	40	47.1
	10:35	-	36	105	14.0	5.0	45	47.6
	10:45	58	38	86	19.0	5.0	52	58.1
	10:55	60	40	75	25.0	6.0	54	80.0
	11:10	60	42	113	34.0	9.0	60	79.6
	11:25	62	48	116	42.0	8.0	64	69.0
	11:45	64	50	155	53.0	11.0	70	71.0
	12:00	64	50	116	62.0	9.0	75	77.6
	12:20	-	50	156	73.5	11.5	76	73.7
	12:45	66	48	195	84.7	11.2	80	57.4
	Total			1308		84.7	Avg. =	64.8

The results of the field emission portion of the method were discussed in Quarterly Data Report #4. To summarize, 15 core intervals (14 of which were oil shale cores) from the inclined holes were tested in the field for gas emission. No emission occurred in 13 of the cores and only a very small amount in the other two--58 ml and 22 ml in cores from NQ-7B. Laboratory analyses of the samples indicated that of the 58 ml, 0.19 mole percent was methane and the remainder was air. The entire 22 ml sample was air.

Two cores from NQ7B were transported in sealed containers to determine if gas was emitted during transportation or storage. It was determined that measurable gas emissions occurred during handling and storage and that the evolved gas compared with the total "remaining gas" is large enough to be significant.

The remaining gas (mill gas) was determined by grinding the shale in a gas-tight ball mill. Gas chromatography was used to identify and quantify the gases produced. Gases evolved through grinding were methane, carbon dioxide and trace hydrocarbons (C^2 through C^6). Sixteen determinations of "remaining gas" were performed. Table II B-7 lists the results of the residual gas tests and Table II B-8 gives the quantities of trace hydrocarbons in the mill gas.

Table II B-7

RESIDUAL GAS, OIL YIELD, DENSITY AND WEIGHT

Core Hole	Footage	Methane SCF/ton	Oil Yield GPT	Carbon Dioxide SCF/ton	Density Grams/cc	Weight of Core Grams
NQ-4						
	1336-1338	0.03	6.5	0.87	2.28	1297
	1370.5-1372.4	0.82	11.5	24.7	2.16	1139
	1390.5-1392.5	19.4	55.5	15.4	1.76	1006
	1420-1422	6.52	34.4	9.30	2.07	1213
NQ-22						
	1634.45-1636.4	1.18	14.9	12.6	2.24	*
	1591-1593	2.10	8.1	3.78	Ø	*
	1652-1654	5.37	35.4	6.00	2.01	*
	1676-1678	2.10	24.7	3.78	2.21	*
NQ-7B						
	1501.3-1503.25	.16	7.7	5.44	2.44	1570
	1552.5-1555.0	2.76	11.7	1.93	2.32	1327
	1563.1-1565.1	18.2	24.7	13.1	2.22	1282
	1573.4-1575.4	32.6	63.0	Ø	1.70	1185
	1609.4-1611.4	9.5	29.4	14.0	2.09	1118
NQ-12D						
	1448.73-1450.6	2.74	26.6	26.0	2.10	#
	1469-1471	3.83	46.0	8.62	1.88	#
	1490.7-1492.6	0.64	40.5	7.55	2.22	#
	1618-1620	R̸	7.8	R̸	Ø	#

* TOSCO did not receive all of the core sample, Core Labs had taken approximately half

Ø Omitted by error

# Request for weight was after half had been used

R̸ Initial results <.05 SCF/ton, did not repeat after method was established

Table II B- 8

TRACE HYDROCARBONS IN MILL GAS

Core Hole Footage	Concentration of Gas in vppm				
	$\Sigma \underline{C}_2$	$\Sigma \underline{C}_3$	$\Sigma \underline{C}_4$	$\Sigma \underline{C}_5$	$\Sigma \underline{C}_6$
NQ-7B					
1501.3-1503.25	8.6	4.8	ND	ND	ND
1552.5-1555.0	14	Trace	ND	ND	ND
1563.1-1565.1	120	32	15	8	ND
1573.4-1575.4	138	15	52	42	ND
1609.4-1611.4	74	28	9	16	ND
NQ-12D					
1448.73-1450.6	67	29	17	ND	ND
1469-1471	93	40	45	44	Trace
1490.7-1492.6	78	35	21	Trace	ND
1618-1620	NA	NA	NA	NA	NA
NQ-4					
1336-1338	ND	ND	ND	ND	ND
1370.5-1372.4	45	17	1.6	ND	ND
1390.5-1392.5	62	26	10	11	ND
1420-1422	68	28	11	ND	ND
NQ-22					
1634.45-1636.4	48	22	7.5	ND	ND
1591-1593	56	35	26	7	ND
1652-1654	100	36	16	35	ND
1676-1678	80	41	30	32	ND

ND=Not Detected
NA=Not Applicable

II C AIR QUALITY

The current air quality/meteorology network is shown on Figure II C-1 and now includes five air quality trailers, the meteorological tower, two acoustic sounders, three ground-level, mechanical weather stations and an area-wide visibility site. Trailers 020, 021 and 022 are located in the Piceance Creek Valley at Redd Ranch, Rock School and the Gerald Oldland Ranch, respectively. Trailers 023 and 024 are located on the Tract plateau. The sounders are co-located with Trailers 021 and 023. The mechanical weather stations are located in the Piceance Valley in Section 9 (T2S, R97W) near Dudley Bluffs (MRI 1), on the northwest corner of the Tract in Section 2 (T3S, R97W) near Scandard Gulch (MRI 2) and near the southern edge of the Tract in Section 17 (T3S, R96W) near the West Fork of Stewart Gulch (MRI 3). The visibility site is located off-Tract in the southwest quarter of the southwest quarter of Section 19 (T3S, R97W) along the Hunter Creek road near Dry Gulch. The reader is referred to Tables II C-1 and II C-2 of the Quarterly Data Report #5 for specific data measurements and sampling frequencies.

The air quality discussion is divided into paragraphs as follows: Air Quality and Surface Meteorology, Low Altitude Meteorology, Upper Air Studies, Visibility, Noise and Atmospheric Diffusion Studies.

II C-1 Air Quality and Surface Meteorology

Tables II C-1 through II C-5 summarize the maximum concentrations for the gases and particulates from June through August that correspond to the appropriate time intervals as determined by State and Federal regulations. Table II C-6 is the frequency distribution by concentration per trailer for particulates and shows the geometric mean for the three months. Tables II C-7 through II C-15 tabulate the monthly maximum, sliding one-hour averages. In the case of hydrocarbons and the particulates, these maxima are for the 6:00 - 9:00 a.m. interval and 24-hour period, respectively. These are shown with the corresponding date, time of day, wind direction and speed. Monthly averages follow on Table II C-16.

The minimum detectable limits for most of these air-quality instruments are stated to be at 5 ppb with the exception of the ozone instrument which is given as 0.5 ppb. In practice the lower reliable detectable limit for the non-methane hydrocarbons is considerably above this; these data represent some of the least reliable. The C-b Tract ambient air concentrations for all the gases, except for ozone and methane, are frequently near or below the measuring instrument's minimum detectable limit. Inherent measurement inaccuracies in most air quality instruments, particularly at or near their lower detectable limits, necessarily make much of the air-quality data interpretation a matter of judgement and experience.

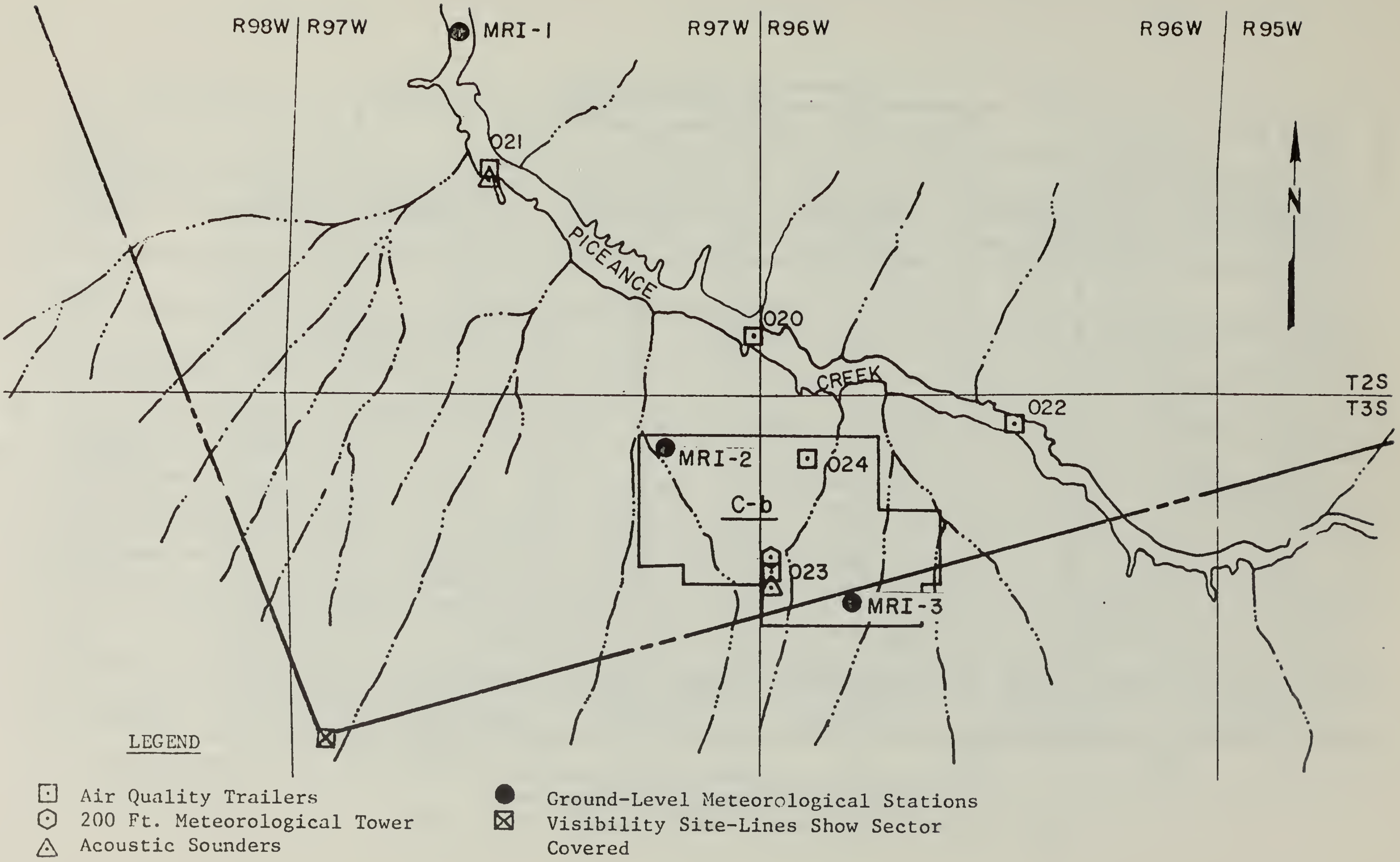


Figure II C-1 AIR QUALITY AND METEOROLOGICAL STATION LOCATIONS

Table II C-1 QUARTERLY SUMMARY (June '75 - August '75)

(Concentrations in micrograms per cubic meter)

TRAILER NO. 20

Recorded Parameter	Average	Maximum 24-hr. Concentration		Maximum 8-hr. Concentration		Maximum 3-hr. Concentration		Maximum 1-hr. Concentration		Maximum 5-min. Concentration	
		Value	Time	Value	Time*	Value	Time*	Value	Time*	Value	Time*
SO_2	1.1	19.2	6/22 13:00			20.7	6/23 3:00	33.9	7/14 13:10	143.3	7/14 12:05
H_2S	0.1							21.7	6/15 6:00	70.6	8/23 10:35
Particulates	14.3[1]	49	8/29								
Total Hydro-carbons	880.7					1027.6	8/15 6:00			3254.2	7/14 18:55
CH_4	848.8					1009.0	8/14 6:00			3254.2	7/14 18:55
Non-CH_4 Hydrocarbons	34.3					141.2	6/21 6:00			1295.9	7/14 18:45
O_3	64.5							160.4	6/26 14:00	170.0	6/26 14:05
NO_x	11.9							53.2	8/17 6:35	91.7	8/11 12:15
NO	7.9							38.1	8/17 1:55	69.3	8/11 12:15
CO	808.6			2120.1	8/12 0.55			3108.0	6/4 13:25	4762.6	6/4 5:50
NO_2	4.0							33.9	7/14 13:10	44.9	8/17 9:50

[1] - Geometric Mean,

*Start of interval of occurrence.

Table II C-2 **QUARTERLY SUMMARY** (June '75 - August '75)
(Concentrations in micrograms per cubic meter)

TRAILER NO. 21

Recorded Parameter	Average	Maximum 24-hr. Concentration		Maximum 8-hr. Concentration		Maximum 3-hr. Concentration		Maximum 1-hr. Concentration		Maximum 5-min. Concentration	
		Value	Time	Value	Time*	Value	Time*	Value	Time*	Value	Time*
SO_2	1.8	43.1	6/16 9:00			66.4	6/16 12:55	67.9	6/16 13:45	117.2	6/16 13:00
H_2S	0.4							13.8	6/16 11:40	36.0	8/26 11:55
Particulates	14.0[1]	75.0	6/19								
Total Hydro-carbons											
CH_4											
Non-CH_4 Hydrocarbons											
O_3											
NO_x											
NO											
CO											

1 - Geometric Mean,

*Start of time interval of occurrence.

Table II C-3 QUARTERLY SUMMARY (June '75 - August '75)

(Concentrations in micrograms per cubic meter)

TRAILER NO. 22

Recorded Parameter	Average	Maximum 24-hr. Concentration		Maximum 8-hr. Concentration		Maximum 3-hr. Concentration		Maximum 1-hr. Concentration		Maximum 5-min. Concentration	
		Value	Time	Value	Time*	Value	Time*	Value	Time*	Value	Time*
SO_2	0.8	14.1	6/11 3:00			26.9	6/12 0:00	27.4	6/12 0:00	80.8	8/24 7:40
H_2S	0.3							11.9	6/15 19:45	29.1	7/29 9:15
Particulates	11.7[1]	69.0	7/24								
Total Hydrocarbons											
CH_4											
Non-CH_4 Hydrocarbons											
O_3											
NO_x											
NO											
CO											

1 - Geometric Mean.

*Start of time interval of occurrence.

Table II C-4 QUARTERLY SUMMARY (June '75 - August '75)

(Concentrations in micrograms per cubic meter)

TRAILER NO. 23

Recorded Parameter	Average	Maximum 24-hr. Concentration		Maximum 8-hr. Concentration		Maximum 3-hr. Concentration		Maximum 1-hr. Concentration		Maximum 5-min. Concentration	
		Value	Time	Value	Time*	Value	Time*	Value	Time*	Value	Time*
SO_2	0.9	25.4	8/19 16:00			59.2	8/20 4:00	59.9	8/20 4:15	78.1	7/28 12:10
H_2S	2.9							71.2	7/9 0:10	90.0	7/9 22:15
Particulates	14.6[1]	65.0	6/17								
Total Hydrocarbons	1019.7					1373.4	8/3 6:00			3249.6	7/28 10:40
CH_4	842.1					979.5	8/12 6:00			2253.9	6/24 10:45
Non-CH_4 Hydrocarbons	175.7					520.4	8/3 6:00			2322.9	8/5 9:55
O_3	76.9							152.2	6/26 13:05	156.3	6/26 14:00
NO_x	1.6							28.7	6/28 3:25	91.7	6/28 3:55
NO	0.7							28.7	6/28 3:25	91.7	6/28 3:55
CO	583.0			1327.1	8/9 14:55			1635.9	7/9 11:50	5382.6	6/24 10:45
NO_2	0.9							59.9	8/20 4:15	35.6	7/28 10:35

1 - Geometric Mean.

*Start of interval of occurrence.

Table II C-5 QUARTERLY SUMMARY (June '75 - August '75)

(Concentrations in micrograms per cubic meter)

TRAILER NO. 24

Recorded Parameter	Average	Maximum 24-hr. Concentration		Maximum 8-hr. Concentration		Maximum 3-hr. Concentration		Maximum 1-hr. Concentration		Maximum 5-min. Concentration	
		Value	Time	Value	Time*	Value	Time*	Value	Time*	Value	Time*
SO_2	0.5	14.9	8/2 6:00			24.1	8/2 10:50	33.0	6/23 9:20	104.2	6/23 9:25
H_2S	0.5							70.9	6/22 19:05	148.1	6/22 17:30
Particulates	10.1[1]	52	6/18								
Total Hydrocarbons											
CH_4											
Non-CH_4 Hydrocarbons											
O_3											
NO_x											
NO											
CO											

[1] - Geometric Mean.

*Start of time interval of occurrence.

TABLE II C-6

PARTICULATE CONCENTRATION FREQUENCY DISTRIBUTION

C-b SHALE OIL MONITORING PROJECT

June - August 1975

SITE	020	021	022	023	024
Concentration					
μg/m^3					
>260					
240-260					
220-240					
200-220					
180-200					
160-180					
140-160					
120-140					
100-120					
80-100					
60-80		1	1	2	
40-60	5	2	3	3	3
20-40	26	17	11	17	14
<20	61	72	66	67	74
Total (No. of Samples)	92	92	81	89	91
Geometric Mean (μg/m^3)	14.3	14.0	11.7	14.6	10.1

TABLE II C- 7

1- HOUR MAXIMUM CONCENTRATIONS

SO_2
Constituent

By Month

Trailer	Item	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
020	Value (ug/m^3)	4.6	17.4	2.6	7.6	32.8	7.2	7.6	20.8	33.9	12.4	9.1	20.2
	Date	11/1	12/8	1/14	2/20	3/7	4/12	5/30	6/23	7/14	8/4	9/27	10/22
	Time (MST)	13:50	21:48	16:10	10:55	10:05	11:35	14:50	4:45	13:10	13:20	11:30	8:30
	Wind Direction (Deg.)	204	102	134	275	190	266	292	134	157	299	318	182
	Wind Speed (MPH)	5	1	5	12	8	3	7	7	1	5	6	9
023	Value (ug/m^3)	0.2	97.9	50.6	5.0	12.2	8.2	7.2	3.7	13.2	59.9	9.3	7.6
	Date	11/1	12/21	1/1	2/20	3/29	4/5	5/4	6/23	7/28	8/20	9/1	10/7
	Time (MST)	11:15	1:55	14:30	11:30	22:05	10:05	11:00	12:45	19:15	4:15	8:45	23:55
	Wind Direction (Deg.)	191	156	358	236	201	184	186	199	184	171	211	228
	Wind Speed (MPH)	8	7	4	18	3	18	27	11	11	2	12	10
021	Value (ug/m^3)	32.8	25.8	53.4	23.2	21.3	21.7	34.3	67.9	18.2	16.9	11.3	20.8
	Date	11/1	12/19	1/26	2/21	3/25	4/25	5/5	6/16	7/11	8/17	9/2	10/19
	Time (MST)	1:35	15:45	14:05	5:00	9:00	20:25	10:50	13:45	22:55	12:35	19:00	23:50
	Wind Direction (Deg.)	128	324	176	156	154	288	147	304	127	219	116	125
	Wind Speed (MPH)	5	7	10	5	8	11	5	15	5	7	3	2
022	Value (ug/m^3)	13.0	20.8	5.9	11.7	14.1	2.6	18.2	27.4	14.5	16.3	2.4	13.0
	Date	11/6	12/20	1/25	2/22	3/3	4/17	5/23	6/12	7/23	8/17	9/17	10/17
	Time (MST)	17:00	1:15	14:25	8:45	8:30	3:30	20:55	0:00	0:40	14:10	4:55	6:10
	Wind Direction (Deg.)	120	127	275	107	110	291	82	123	114	275	88	121
	Wind Speed (MPH)	1	6	9	2	5	5	1	7	7	5	2	7
024	Value (ug/m^3)	5.2	128.5	54.3	34.3	50.8	49.1	56.4	33.0	10.6	26.5	20.6	41.7
	Date	11/29	12/10	1/5	2/26	3/3	4/13	5/2	6/23	7/17	8/2	9/7	10/8
	Time (MST)	21:10	6:20	11:50	2:25	22:50	17:35	3:20	9:20	19:55	11:05	4:25	4:20
	Wind Direction (Deg.)	80	12	178	63	60	284	103	212	170	317	114	218
	Wind Speed (MPH)	3	0	9	0	3	5	0	5	8	7	7	10

H_2S
Constituent

TABLE II C-8

1 - HOUR MAXIMUM CONCENTRATIONS

By Month

Trailer	Item	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
020	Value (ug/m^3)	10.1	2.2	6.2	13.7	12.5	2.2	1.2	21.7	2.9	5.9	1.7	2.1
	Date	11/9	12/8	1/13	2/19	3/7	4/2	5/9	6/15	7/29	8/23	9/30	10/1
	Time (MST)	20:00	7:10	14:05	12:35	10:05	13:30	13:20	6:00	10:50	10:25	9:50	14:50
	Wind Direction (deg.)	111	104	174	186	190	208	225	130	201	230	288	345
	Wind Speed (MPH)	0	1	1	7	8	5	7	6	5	9	7	4
023	Value (ug/m^3)	3.2	45.3	28.4	8.2	19.1	6.5	6.9	8.0	71.2	38.5	15.1	1.8
	Date	11/12	12/21	1/1	2/26	3.7	4/14	5/1	6/25	7/9	8/20	9/4	10/28
	Time (MST)	5:40	1:55	11:10	6:05	18:55	6:55	6:35	18:05	0:10	4:40	7:45	11:45
	Wind Direction (Deg.)	123	156	315	156	165	113	238	316	57	257	15	277
	Wind Speed (MPH)	4	7	4	2	7	5	1	19	3	2	2	3
021	Value (ug/m^3)	58.9	4.6	4.7	9.5	7.3	4.3	9.0	13.8	3.5	8.3	6.9	13.8
	Date	11/18	12/7	1/31	2/7	3/21	4/26	5/9	6/16	7/8	8/17	9/3	10/18
	Time (MST)	1:25	8:00	4:35	17:10	21:30	23:20	1:30	11:40	1:40	12:35	0:05	3:05
	Wind Direction (Deg.)	123	337	138	163	117	350	151	294	143	219	119	58
	Wind Speed (MPH)	0	2	5	12	6	3	3	13	3	7	2	1
022	Value (ug/m^3)	4.7	8.4	2.4	14.3	14.1	10.1	1.3	11.9	5.7	4.3	3.8	11.9
	Date	11/18	12/8	1/25	2/28	3/1	4/11	5/28	6/15	7/14	8/23	9/1	10/22
	Time (MST)	9:35	0:40	14:25	20:55	0:00	14:00	9:15	19:45	12:55	9:55	9:25	23:00
	Wind Direction (Deg.)	126	69	275	72	102	34	267	57	139	286	186	283
	Wind Speed (MPH)	10	8.5	9	2	5	5	8	1	4	8	4	3
024	Value (ug/m^3)	8.3	7.7	27.6	8.1	8.5	62.5	56.9	70.9	3.0	8.5	10.4	20.9
	Date	11/5	12/24	1/10	2/17	3/23	4/14	5/2	6/22	7/29	8/30	9/7	10/8
	Time (MST)	15:55	1:55	16:45	13:10	2:40	0:35	1:40	19:05	11:55	11:50	2:15	2:20
	Wind Direction (Deg.)	268	154	201	258	89	197	120	232	244	183	124	201
	Wind Speed (MPH)	3	1	2	9	2	6	2	4	8	9	4	9

Particulate
Constituent

TABLE II C-9

24 - HOUR MAXIMUM CONCENTRATIONS

Midnight - Midnight

By Month

Trailer	Item	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
020	Value (ug/m^3)	133.0	11.0	17.0	11.0	39.0	89.0	70.0	48.0	47.0	49.0	44.0	62.0
	Date	11/29	12/12	1/18	2/27	3/22	4/25	5/20	6/18	7/12	8/29	9/2	10/12
	(1)24-hr. ave. Wind Direction (Deg)	121	107	117	124	195	170	236	119	60	144	50	167
	Max. 1-hr. ave. Wind Speed (MPH)	5	8	8	5	14	24	20	12	6	8	8	15
	Wind Speed - 24-hr. ave. (MPH)	2	3	5	4	7	15	10	6	4	5	4	8
023	Value (ug/m^3)	26.0	22.0	6.0	11.0	171.0	112.0	107.0	65.0	42.0	31.0	33.0	81.0
	Date	11/27	12/4	1/11	2/27	3/22	4/25	5/20	6/17	7/1	8/7	9/29	10/7
	(1)24-hr. ave. Wind Direction	174	171	313	192	226	186	234	215	188	210	260	188
	Max. 1-hr. ave. Wind Speed	15	18	16	5	38	41	34	23	18	20	18	30
	Wind Speed - 24-hr. ave.	7	10	8	4	16	27	17	11	9	11	7	16
021	Value (ug/m^3)	71.0	18.0	7.0	10.0	32.0	125.0	97.0	75.0	28.0	37.0	81.0	87.0
	Date	11/21	12/10	1/13	2/28	3/22	4/25	5/20	6/19	7/7	8/17	9/1	10/7
	(1)24-hr. ave. Wind Direction	114	102	4	140	170	168	327	143	56	144	129	124
	Max. 1-hr. ave. Wind Speed	10	9	6	8	20	28	21	14	9	8	14	21
	Wind Speed - 24-hr. ave.	4	4	3	4	9	14	12	9	4	5	7	8
022	Value (ug/m^3)	154.0	116.0	10.0	12.0	44.0	82.0	80.0	55.0	69.0	27.0	60.0	70.0
	Date	11/28	12/1	1/26	2/12	3/21	4/25	5/20	6.18	7/24	8/6	9/24	10/7
	(1)24-hr. ave. Wind Direction	290	137	112	116	168	136	183	121	354	104	106	126
	Max. 1-hr. ave. Wind Speed	9	9?	12	12	9	16	15	8	11	14	10	12
	Wind Speed - 24-hr. ave.	5	5	5	7	5	13	9	5	7	8	7	8
024	Value (ug/m^3)	178.0	8.0	16.0	9.0	27.0	80.0	86.0	52.0	27.0	30.0	26.0	80.0
	Date	11/27	12/5	1/27	2/28	3/22	4/25	5/20	6/18	7/2	8/8	9/7	10/12
	(1)24-hr. ave. Wind Direction	118	261	248	130	196	180	235	205	141	38	204	186
	Max. 1-hr. ave. Wind Speed	8	7	5	8	33	37	30	18	21	14	7	25
	Wind Speed - 24-hr. ave.	4	2	3	4	13	22	14	9	6	5	5	15

(1) Vector Averages

Methane HC
Constituent

TABLE II C-13

3 - HOUR MAXIMUM CONCENTRATIONS
(6-9 a.m.)

By Month

		1974											
Trailer	Item	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
020	Value (ug/m^3)	933.2	1219.5	999.2	1298.0	998.9	(2) 837.8	924.0	862.5	859.2	1009.0	1068.1	1342.9
	Date	11/9	12/8	1/12	2/3	3/15	4/28	5/2	6/2	7/31	8/14	9/18	10/28
	Time (MST)												
	Wind Direction (Deg.)	77	111	118	278	~317	124	172	125	334	110	124	89
	Wind Speed (MPH)	0	2	6	3	-	1	3	6	0	5	5	1
023	Value (ug/m^3)	(1) 96.7	(1) 1925.3	(1) 1137.7	900.1	910.2	902.4	903.9	879.1	879.4	979.5	1029.5	964.3
	Date	11/7	12/29	1/1	2/15	3/3	4/18	5/2	6/6	7/29	8/12	9/12	10/11
	Time (MST)												
	Wind Direction (@ 30')	98	151	144	306	159	228	180	65	179	34	87	174
	Wind Speed (@ 30')	4	3	4	9	0	9	2	4	8	2	3	23
021	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												
022	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												
024	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												

(1) Report data are incorrect because of contaminated manifold.
(2) Reported data may be incorrect because of malfunctioning instrument.

Non-Methane HC
Constituent

Table II C-11

3 - HOUR MAXIMUM CONCENTRATIONS (6-9 am)

By Month

Trailer	Item	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
020	Value (ug/m^3)	197.6	179.7	223.8	51.4	288.6 (2)	707.7 (2)	83.5	141.2	69.6	42.1	319.4	486.9
	Date	11/25	12/19	1/12	2/25	3/31	4/22		6/21	7/7	8/4	9/3	10/28
	Time (MST)												
	Wind Direction (Deg.)	127	101	117	107	128	130	172	68	93	336	122	89
	Wind Speed (MPH)	11	1	7	4	3	6	3	2	0	3	4	1
023	Value (ug/m^3)	(1) 17151.9	(1) 33269.7	(1) 2316	18.1	34.2	302.2	120.0	355.1 (2)	895.6 (2)	520.4	349.6	533.2
	Date	11/23	12/12	1/4	2/28	3/31	4/21	5/26	6/5	7/9	8/3	9/16	10/5
	Time (MST)												
	Wind Direction (Deg.)	28	179	116	182	194	139?	281	22	131	61	139	85
	Wind Speed (MPH)	3	6	6	7	15	1	3	2	5	2	4	3
021	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												
022	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												
024	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												

(1) Reported data are incorrect because of contaminated manifold.
(2) Reported data may be incorrect because of malfunctioning instrument.

Table II C-12

CO
Constituent

1 - HOUR MAXIMUM CONCENTRATIONS

By Month

1974

Trailer	Item	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
020	Value (ug/m3)	1353.8	1853.7	1700.8	1716.6 (2)	3680.4 (2)	1811.5 (2)	3296.9 (2)	4650.9 (2)	2065.3 (2)	(3)	(3)	(3)
	Date	11/14	12/15	1/11	2/19	3/16	4/11	5/29	6/4	7/29			
	Time (MST)	11:55	13:30	19:30	10:05	11:25	13:35	18:20	4:55	14:55			
	Wind Direction (Deg.)	113	117	341	115	147	360	126	108	219			
	Wind Speed (MPH)	0	1	6	5	12	5	6	1	5			
023	Value (ug/m3)	14563.1 (1)	5061.4 (1)	2563.2 (1)	769.7	2421.1	740.9	1155.9	790.8	1635.9	(3)	(3)	(3)
	Date	11/14	12/19	1/23	2/3	3/24	4/26	5/27	6/26	7/9			
	Time (MST)	15:25	4:50	17:15	15:05	13:20	7:20	17:15	22:10	11:50			
	Wind Direction (Deg.)	210	246	214	202	206	39	96	114	175			
	Wind Speed (MPH)	11	10	7	10	12	5	13	5	3			
021	Value (ug/m3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												
022	Value (ug/m3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												
024	Value (ug/m3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												

(1) Reported data are incorrect because of contaminated manifold.
(2) Reported data may be incorrect because of malfunctioning instrument.
Data will be reported at later date.

NO
Constituent

TABLE II C-13

1 - HOUR MAXIMUM CONCENTRATIONS

By Month

Trailer	Item	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
020	Value (ug/m^3)	44.3	16.4	43.7	7.8	4.7	27.1	34.0	29.8	3.1	38.1	26.5	34.2
	Date	11/10	12/9	1/22	2/19	3/19	4/26	5/25	6/1	7/31	8/17	9/4	10/13
	Time (MST)	5:50	7:05	7:30	9:35	19:15	14:30	2:35	8:55	22:20	1:55	23:10	3:35
	Wind Direction (Deg.)	131	106	105	126	122	235	9	294	129	132	101	101
	Wind Speed (MPH)	0	2	1	8	4	11	3	3	4	6	3	2
023	Value (ug/m^3)	38.5	93.9	114.2	52.6	16.7	10.1	4.2	28.7	15.3	17.0	16.5	9.0
	Date	11/28	12/24	1/17	2/9	3/17	4/27	5/8	6/28	7/13	8/16	9/14	10/18
	Time (MST)	8:10	1:05	9:55	9:25	11:40	7:25	11:40	3:25	4:30	23:20	20:05	1:00
	Wind Direction (Deg.)	303	263	116	179	9	328	295	240	83	88	93	132
	Wind Speed (MPH)	11	4	3	11	10	11	10	5	4	3	4	5
021	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												
022	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												
024	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												

NO_2
Constituent

TABLE II C-14

1 - HOUR MAXIMUM CONCENTRATIONS

By Month

Trailer	Item	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
020	Value (ug/m^3)	26.7	36.0	17.6	14.4	11.2	16.7	17.0	20.8	33.9	12.4	9.1	20.2
	Date	11/26	12/3	1/25	2/1	3/19	4/18	5/10	6/23	7/14	8/4	9/27	10/22
	Time (MST)	22:30	17:10	6:35	0:45	18:40	16:20	19:45	4:45	13:10	13:20	11:30	8:30
	Wind Direction (Deg.)	95	120	106	107	137	277	127	134	157	299	318	182
	Wind Speed (MPH)	3	0	4	2	5	11	4	7	1	5	6	9
023	Value (ug/m^3)	21.2	47.0	68.2	9.2	4.8	10.1	8.0	3.7	13.2	59.9	9.3	7.6
	Date	11/26	12/6	1/16	2/23	3/23	4/28	5/1	6/23	7/28	8/20	9/1	10/7
	Time (MST)	16:00	13:10	9:15	20:10	7:10	19:40	8:35	12:45	19:15	4:15	8:45	23:55
	Wind Direction (@30')	315	57	143	179	146	60	95	199	184	171	211	228
	Wind Speed (@ 30')	7	5	4	4	4	6	5	11	11	2	12	10
021	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												
022	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												
024	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												

O_3
Constituent

TABLE II C-15

1 - HOUR MAXIMUM CONCENTRATIONS

By Month

Trailer	Item	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
020	Value (ug/m^3)	108.1	117.9	130.9	146	146.2	115.3	124.5	160.4	130.9	114.0	80.8	56.2
	Date	11/27	12/12	1/29	2/19	3/26	4/22	5/22	6/26	7/15	8/2	9/18	10/5
	Time (MST)	11:50	11:45	12:00	15:55	9:00	11:50	6:40	14:00	16:45	16:35	17:20	13:10
	Wind Direction (Deg.)	141	133	124	184	130	221	104	170	63	302	308	313
	Wind Speed (MPH)	-	0	4	7	4	9	3	6	0	8	12	5
023	Value (ug/m^3)	64.6	68.5	97.7	136	145.9	116.1	139.5	152.2	129.9	127.0	135.3	58.0
	Date	11/18	12/30	1/28	2/23	3/8	4/27	5/22	6/26	7/14	8/31	9/7	10/5
	Time (MST)	13:20	13:25	13:15	21:45	11:40	14:20	6:25	13:05	11:15	22:10	10:00	10:50
	Wind Direction (Deg.)	209	-	269	306	197	276	197	228	325	171	262	281
	Wind Speed (MPH)	20	2	12	3	15	9	3	10	5	7	5	8
021	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												
022	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												
024	Value (ug/m^3)												
	Date												
	Time (MST)												
	Wind Direction (Deg.)												
	Wind Speed (MPH)												

TABLE II C-16. MONTHLY AVERAGE AMBIENT AIR CONSTITUENT CONCENTRATIONS OF GASES AND PARTICULATES ($\mu g/m^3$)

1974-1975

Trailer	Item	Month											
		Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
020	NO ($\mu g/m^3$)	1.9	0.7	3.4	*0.4	*0.3	9.6	17.8	*3.2	*0.4	9.1	*3.2	3.5
023		4.4	*12.8	14.7	0.4	*1.2	0.6	0.1	0.3	0.6	1.4	0.6	0.3
020	NO_2 ($\mu g/m^3$)	2.8	6.8	4.5	*2.5	*1.2	2.7	4.1	*0.3	*1.7	4.7	*3.0	7.9
023		2.4	*4.7	7.4	0.2	*0.4	0.9	0.5	0.0	1.5	1.0	0.1	0.7
020	O_3 ($\mu g/m^3$)	58.0	69.3	93.7	105.1	88.0	77.1	71.5	69.1	74.6	50.8	41.1	32.8
023		*31.4	28.0	42.4	85.8	85.6	90.5	87.3	84.4	86.1	61.0	53.4	43.3
020	Non-Methane H.C. ($\mu g/m^3$)	73.4	97.4	*75.7	23.4	38.6	327.6(2)	38.9	50.8	25.8	27.9	58.9	75.9
023		933.0(1)	20213.6(1)	*662.8(1)	22.1	*17.1	49.1	43.3	196.5	220.2	145.6	92.2	331.8
020	CH_4 ($\mu g/m^3$)	826.1	918.8	*908.1	879.4	829.8	590.6(2)	833.6	821.2	825.9	908.8	949.3	935.6
023		825.5	1053.8(1)	*943.6(1)	*833.7	*859.8	836.3	834.3	814.7	780.7	902.7	933.4	814.1
020	CO ($\mu g/m^3$)	553.8	676.9	908.2	1228.5(2)	1498.0(2)	*853.0(2)	1815.5(2)	1092.1(2)	206.5(2)	(4)	(4)	(4)
023		3703.6(1)	2439.3(1)	1786.2(1)	391.4	504.5	485.8	699.9	437.0	468.5			
020	SO_2 ($\mu g/m^3$)	0	1.8	0	0.1	1.1	0.1	0	1.0	1.6	0.9	0.7	1.4
021		1.3	1.7	0.8	0.8	0.6	1.2	1.1	2.1	1.3	1.9	1.7	1.8
022		2.6	0.1	0	0.2	0	0	0.5	1.7	0.4	0.6	0	0.6
023		0	6.4	3.3	0.1	0.6	0.5	0	0.0	0.6	2.0	0.9	0.2
024		0.2	1.7	1.3	5.5	0.9	1.1	0.7	0.6	0.1	0.9	0.7	2.0
020	H_2S ($\mu g/m^3$)	0	0	0	0	0.4	0	0	0.2	0	0	0.1	0.1
021		1.6	0	0.2	0.8	0.4	0.2	0.4	0.7	0.2	0.4	0.7	0.8
022		0.2	1.2	0	0.2	0.3	0.7	0	0.4	0.2	0.3	0.4	0.2
023		0	5.2	2.5	0.7	2.7	0.5	0.3	0.3	4.8	2.4	2.1	0
024		0	0.1	0	0.2	0.4	1.0	0.3	1.1	0.1	0.1	0.6	1.0
020	Particulate ($\mu g/m^3$)	*48.7(3)	4.3	3.3	3.8	6.5	11.6	12.4	10.7	14.7	18.6	12.8	11.2
021		*20.4	5.4	4.0	4.5	6.9	13.7	13.2	12.3	15.6	14.3	12.4	12.4
022		*35.3	4.2	2.9	3.2	5.3	11.9	11.2	9.5	14.6	11.5	12.6	9.7
023		*18.0	*6.8	*2.5	4.2	11.5	15.4	19.3	18.3	14.4	11.7	11.1	13.7
024		*117.0	2.9	2.3	3.8	4.9	10.2	11.4	8.7	11.3	10.6	9.8	12.4

* 50% Or Less Data

(1) Reported data are incorrect because of contaminated manifold.

(2) Reported data may be incorrect because of possible malfunctioning instrument.

(3) Very few particulate data points available for November 1974. The values reported were unduly influenced by the occurrence of a few unusually high 24-hour concentrations.

(4) Data will be reported at a later date.

The August-through-October data as reported in the Radian monthly data reports show the majority of ambient sulfur dioxide (SO_2) and hydrogen sulfide (H_2S) concentrations to be below the 5 ppb (13 ug/m^3, SO_2 and 7 ug/m^3, H_2S) minimum detectable limit of the instrumentation. Because the majority of the recorded five-minute averages appear as zeroes, the computed monthly averages (Table II C-16) for these two gases are often reported as less than the stated minimum detectable limits.

During this period, the highest monthly one-hour maxima concentrations occurred on the plateau for both SO_2 and H_2S (Tables II C-7 and II C-8, respectively). SO_2 levels above the minimum detectable limit of the instrument are recorded more frequently in the valley. H_2S concentrations above these minimum detectable limits occur with greater frequency on the plateau.

Near-by gas operations may be a potential source for H_2S, the primary pollutant (i.e., emitted directly into the air), which can subsequently be oxidized in the atmosphere to SO_2, the secondary pollutant (i.e., formed by atmospheric chemical reactions from primary pollutants). Therefore, it would be reasonable to assume that, under certain meteorological conditions, a similar correlation for these two gases with wind direction would be observed. In fact the bivariant frequency distributions of wind direction vs. gas concentration for SO_2 and H_2S shown in the October Radian monthly data report do indicate a very similar pattern for these two gases at Trailer 024. The maximum concentrations coincide approximately to a south-southeast wind direction. That a discernable pattern occurs only at Trailer 024 during October would indicate that the gases are not widely dispersed at that point and may exist as a narrow and well-defined "plume" from a nearby source.

The monthly one-hour maxima for ozone shown in Table II C-15 in Piceance Valley show a significant decrease from the previous reporting period and are the lowest one-hour maximum concentrations to date. Moreover, beginning in August and continuing through October, the monthly ozone averages for this gas (Table II C-16) indicate a trend toward lower ambient concentrations. Thus, in addition to the diurnal trend observed in previously reported data, there appears to be seasonal trend also.

The diurnal trend for ozone on the plateau at Trailer 023 is less well defined during September and October than the previous quarter. A similar phenomenon was observed during last year's fall and winter months.

Ozone in a polluted atmosphere is considered a secondary pollutant and is the result of photochemically-induced reactions involving other pollutants, primarily oxides of nitrogen (NO_x) and non-methane hydrocarbons (NMHC). Both the absolute concentrations of these precursors and their concentration ratios are important. Sunlight intensity and duration and temperature are among some of the other important factors which can influence the production of ozone. Moreover, atmospheric stagnation conditions can be favorable for ozone formation by allowing the build-up of the precursors and prolonging the period of time in which the reactions can occur.

In addition to the possibility that ozone levels at the Tract are influenced by the photochemical reactions involving both anthropogenic and naturally-occurring hydrocarbons and oxides of nitrogen, ozone transport from the stratosphere may also influence the ground-level ozone concentrations. Stratospheric ozone transport may have its most noticeable effect on the seasonal variations of ozone and might tend to cause higher ozone concentrations during the spring and summer and lower concentrations during the fall and winter.

During the August-through-October period there were several factors that undoubtedly influenced the ambient concentrations of nitric oxide (NO), nitrogen dioxide (NO_2), methane (CH_4), non-methane hydrocarbons (NMHC), carbon monoxide (CO) and particulates. There was increased automobile traffic and campfire burning with the advent of the deer and elk hunting season. On September 19, a small forest fire originated just east of Tract C-b. During the period of October 11 to approximately October 24, the largest forest fire since the 1890's occurred near Burns, Colorado, forty miles to the east of the Tract and destroyed over 4500 acres of forest. A fire of this magnitude would have made a substantial impact on the levels of the above-mentioned gases over a very wide area for a prolonged period of time.

Tables II C-13 and II C-14 show the monthly one-hour maxima for nitric oxide (NO) and nitrogen dioxide (NO_2), respectively. The monthly averages are given in Table II C-16. The August-through-October data indicate generally higher, ambient concentrations for both gases. These ambient concentrations were frequently above the global background concentrations of 0.25 - 2.5 ug/m^3 for NO and 1.9 - 2.6 ug/m^3 for NO_2.

The monthly 6 - 9 a.m. maxima for methane (CH_4) and for non-methane hydrocarbons (NMHC) are reported in Tables II C-10 and II C-11, respectively. The monthly averages are reported in Table II C-16. The October 6 - 9 a.m. maxima concentrations in the valley at Trailer 020 for both CH_4 and NMHC are the highest yet reported at that location. Trailer 023 on the plateau continues to record relatively high NMHC values which began in June. The September 6 - 9 a.m. maximum for CH_4 at Trailer 023 is the highest such concentration reported to date at this location.

In general, the NMHC and CH_4 ambient concentrations during the August-through-October period are high when compared to the preceeding data of the first year's baseline. The cause of the persistently higher NMHC concentrations on the plateau is not obvious. The possibility of volatile organic compounds being emitted into the atmosphere from plant species throughout the basin would be expected to produce a more homogeneous atmosphere with respect to these compounds.

The carbon monoxide data reported in the August-through-October Radian monthly reports and included as part of Quarterly Data Report #5 are in error. This will be corrected and reported at a later date.

The particulate 24-hour maxima and monthly averages are reported in Tables II C-9 and II C-16. The August-through-October monthly averages generally show somewhat higher concentrations in the valley at Trailers 020, 021 and 022 than on the plateau at Trailers 023 and 024. The valley ambient concentrations are probably influenced by automobile traffic and by agriculturally-related activities along the valley's meadows. The October 24-hour maxima are the highest during the August-through-October period. These higher concentrations seem to be coincident with somewhat higher wind speeds for the month.

The full April-June Radian data for particulate trace elements are reported in Quarterly Data Report #5 and a summary of these data appeared in Quarterly Data Report #4 in Tables II C-17, C-18 and C-19. There are no new particulate trace element data at the time of this report. The volatile trace metal program (not required) is being re-evaluated and there are no additional data to be reported at this time.

The final quarter of the one-year baseline, particulate size distribution (not required) is reported in the data report and is summarized below.

Size Range in Microns	Concentration in ug/m^3
7.0 - above	3.66
3.3 - 7.0	3.05
2.0 - 3.3	2.01
1.1 - 2.0	0.91
0.01- 1.1	4.08(1)

Regarding near-surface meteorology, Tables II C-17 and II C-18 present a meteorological summary of temperature, relative humidity and winds data by trailer for each month to date with the months of August through-October representing new data.

Average hourly temperatures for this reporting period ranged from an hourly maximum of 69°F at Trailer 024 on the plateau to a minimum of -1°F at Trailer 021 in Piceance Valley. It is of interest to note that below-freezing temperatures occurred in the valley during August on three different days. Temperature minima on the plateau were up to 15°F warmer than in Piceance Valley; maxima were up to 7°F warmer on the plateau. On the plateau daily temperature extremes are normally more moderate than in the valley because of the lack of katabatic flow on the plateau. At Trailer 021 in the valley, winds are normally quite light during these drainage flows because of terrain configuration, resulting in a lack of vertical mixing and contributing to formation of strong nocturnal inversions.

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(1) Two soot particles of much larger diameter were observed on the filter; therefore, this is not an accurate ambient air concentration.

TABLE II C-17 METEOROLOGICAL SUMMARY: WIND SPEED & DIRECTION 1974-1975
(30 Foot Height)

Trailer	Item	Month												Annual
		Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	
Tower 200'	Wind Speed, 5-Min. Max. (MPH) &	39	52	48	36	52	56	53	52	42	41	36	49	56
	Associated Direction (Deg.)	203	239	205	209	193	178	179	228	188	229	244	209	178
020	Wind Speed, Hourly Max. (MPH)	11	11	18	18	17	24	20	16	19	17	20	18	24
021		19	13	19	17	20	28	21	20	16	18	16	21	28
022		15	20	18	17	19	17	15	17	15	17	19	15	20
023		25	38	32	24	38	43	38	28	25	22	21	33	43
024		19	25	25	20	33	37	31	25	21	21	23	31	37
020	& Associated Direction (Deg.)	129	129	288	293	118	155	153	300	115	301	295	158	155
021		340	344	347	345	168	162	164	312	296	275	268	135	162
022		105	270	285	285	110	126	131	286	107	287	283	118	270
023		200	246	198	193	189	175	170	213	178	216	273	189	175
024		177	162	197	230	155	172	183	212	111	303	277	175	172
020	Wind Speed, Hourly Avg. (MPH)	3	3	5	5	5	6	6	6	4	5	5	5	5
021		3	4	6	6	6	6	6	6	4	5	5	5	5
022		5	5	6	6	6	6	6	6	5	6	6	6	6
023		7	7	8	8	10	10	9	8	7	8	6	8	8
024		3	3	5	5	7	7	7	7	5	6	5	7	6
020	Wind Direction, Hourly Avg. (Deg.)	114	102	115	126	131	137	137	121	106	124	105	126	120
021		124	95	119	143	142	156	141	136	113	126	107	113	126
022		105	106	104	111	105	116	106	85	94	114	94	120	105
023		197	232	202	200	202	218	217	199	164	188	216	190	202
024		95	96	129	108	153	191	186	162	109	136	82	150	133

TABLE II C-18 METEOROLOGICAL SUMMARY: TEMPERATURE AND RELATIVE HUMIDITY 1974-1975

Trailer	Item	Month												Annual
		Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	
020	Temperature, Hourly Max. (°F)	50	45	50	47	59	69	78	87	89	88	83	77	89
021		52	46	53	49	57	68	78	88	90	90	83	79	90
022		53	47	53	47	55	68	77	78	87	89	83	78	89
023		48	49	43	42	50	68	71	83	84	82	78	71	84
024		—	37	51	47	55	62	77	87	90	90	83	74	90
020	Temperature, Hourly Min. (°F)	-14	-30	-46	-24	-28	-19	15	30	42	29	17	0	-46
021		-17	-34	-51	-29	-28	-21	16	25	37	29	14	-1	-51
022		0	-22	-38	-22	-23	-15	14	31	45	32	19	2	-38
023		5	0	-5	0	-6	6	22	34	51	40	29	14	-6
024		—	-8	-29	-10	-18	-5	28	32	51	38	24	9	-29
020	**Temperature, Hourly Avg. (°F)**	27	13	15	19	32	36	48	58	67	63	53	42	39
021		27	11	15	20	30	35	47	56	67	63	53	40	39
		29	15	18	21	30	36	48	56	68	64	55	45	40
		32	25	23	24	31	35	46	56	67	65	56	47	42
		—	15	22	24	32	38	49	61	71	69	58	45	44
020	Rel. Hum., Hrly Max. (%)	100	100	96	98	100	99	100	98	99	99	98	100	100
021		85	95	100	100	100	100	100	100	100	100	100	100	100
022		100	100	100	100	100	100	100	100	90	100	100	100	100
023		100	100	100	100	100	100	100	100	100	87	93	100	100
024		100	100	100	100	100	100	100	95	96	94	99	100	100
020	Rel. Hum., Hrly Min. (%)	22	23	24	22	23	15	12	9	10	12	13	13	9
021		19	22	26	29	30	22	12	8	10	11	15	15	8
022		26	27	30	27	28	19	17	19	21	16	17	17	16
023		24	25	26	32	37	32	28	25	28	12	16	15	12
024		25	25	26	26	28	16	16	11	12	15	16	16	11
020	Rel. Hum., Hrly Avg. (%)	66	72	66	65	64	56	54	47	49	39	41	46	55
021		63	74	75	73	70	65	58	53	56	43	49	55	61
022		70	74	71	71	70	61	58	59	57	44	45	49	61
023		63	69	68	72	72	67	64	54	54	29	35	40	57
024		62	69	65	66	66	55	51	38	45	34	38	41	53

Hourly-average relative humidities for the quarter have ranged from a minimum of 11 percent to a maximum of 100 percent. Averages ranged from 39 to 55 percent in Piceance Valley down to 29 to 41 percent on the Tract. The highest diurnal range in humidity of 80 percent occurred at Trailer 021 on October 22.

Precipitation recorded for this reporting period reached a monthly maximum of 0.94 inches in August. Cumulative readings, since the beginning of the year, are affected by trailer downtime (i.e., lack of power) as indicated on Table II C-19, by as much as 3.35 inches (Trailer 024). Normals at both Grand Junction and Rifle are shown on the same table. C-b Tract precipitation to date is lighter than either Grand Junction or Rifle. Three precipitation programs (air quality, U.S.G.S. and microclimate) on the Tract recorded the following monthly average precipitation (inches) for May through August 1975:

Program	Monthly Average Precipitation (In.)			
	May	June	July	August
5 Air Quality Stations (includes estimated losses)	0.67	0.69	0.61	0.57
2-4 U.S.G.S. Stations	0.56	1.02	0.74	0.53
10-14 Microclimate Stations	0.95	1.40	0.76	0.65
Grand Junction NWS	1.23	0.43	1.39	0.09
Rifle, Colorado (Norm.)	0.79	0.69	0.98	1.20

Five-minute-maximum wind speeds have reached 49 mph in this reporting period. Hourly maxima on the plateau have reached 33 mph and 21 mph in Piceance Valley. Hourly average wind speeds were in the 5 to 8 mph range. Typical monthly wind roses on the plateau and in the valley are presented in Figures II C-2 and II C-3 for Trailers 023 and 021, respectively. Associated predominant directions continue to the south-southwest on the plateau and east to southeast in the valley.

In Reference 11 of *Quarterly Data Report #5*, Marlatt has reported some preliminary extreme wind analysis for Tract C-b in order to furnish some structural design criteria. Figure II C-4 from this reference yields the probability (P) or risk of an annual extreme wind exceeding some design wind value, x, $[P = 1-F(x)$ where $F(x)$ is plotted$]$ for C-b as a function of x. Note that the probability of at least one extreme wind exceeding this value in m years is $[P_m=1-(F(x))^m]$ and $R=1/(1-F(x))$ where R is the return period. Thus, if the design life of the project (m) is 30 years, there is a 5 percent risk (i.e. $P_m=0.05$) that a design wind of 115 mph (30-second gust) is exceeded at least once. For a ten percent risk the design wind speed drops to 110 mph. If the project 30-year design life is equated to the return period (R) then the design wind speed at the 5 percent risk level drops to 92 mph.

Table II C-19 PRECIPITATION TOTALS FOR C-b AND NORMALS FOR GRAND JUNCTION AND RIFLE (WATER EQUIVALENT IN INCHES)

(1975)	MEASURED @ C-b TRAILER NO.					ESTIMATED LOSSES DUE TO TRAILER DOWNTIME*					MEASURED VALUES PLUS ESTIMATED LOSSES					GRAND JUNCTION NATIONAL WEATHER SERVICE	MONTHLY NORMAL PRECIPI-TATION AT GRAND JUNCTION	DEPARTURE FROM NORMAL	MONTHLY NORMAL AT RIFLE, COLORADO
MONTH	020	021	022	023	024	020	021	022	023	024	020	021	022	023	024				
January	0.18	0.25	0.20	0.38	0.20	0.10	0.02	--	--	0.01	0.28	0.27	0.20	0.38	0.21	0.53	0.64	-0.11	0.92
February	0.00	0.04	0.08	0.06	0.13	--	--	--	--	--	0.00	0.04	0.08	0.06	0.13	0.49	0.61	-0.12	0.80
March	0.31	0.45	0.38	0.51	0.72	--	--	0.01	0.25	--	0.31	0.45	0.39	0.76	0.72	1.74	0.75	+0.99	0.91
April	0.32	0.20	0.42	0.49	0.66	--	--	--	--	0.07	0.32	0.20	0.42	0.49	0.73	1.38	0.79	+0.59	1.01
May	0.25	0.51	0.54	1.22	0.57	--	--	--	--	0.28	0.25	0.51	0.54	1.22	0.85	1.23	0.63	+0.60	0.79
June	0.28	0.73	0.10	0.27	0.07	0.20	--	0.66	0.46	0.68	0.48	0.73	0.76	0.73	0.75	0.43	0.55	-0.12	0.69
July	0.41	0.30	0.85	0.53	Inoper-ative	0.11	--	--	0.01	0.85	0.52	0.30	0.85	0.54	0.85	1.39	0.46	+0.93	0.98
August	0.44	Inoper-ative	0.94	0.13	Inoper-ative	0.03	0.03	0.06	0.04	1.17	0.47	0.03	1.00	0.17	1.17	0.09	1.05	-0.96	1.20
September	0.05	0.06	0.09	0.19	0.10	0.08	--	0.22	0.09	0.29	0.13	0.06	0.31	0.28	0.39	0.16	0.84	-0.68	0.92
October	0.83	0.54	0.25	0.17	0.62	--	--	0.61	0.52	--	0.83	0.54	0.86	0.69	0.62	0.56	0.93	-0.37	1.09
TOTALS	3.07	3.08	3.85	3.95	3.07	0.52	0.05	1.56	1.37	3.35	3.59	3.13	5.41	5.32	6.42	8.00	7.25	+0.75	9.31

*Estimated by Radian Corp.

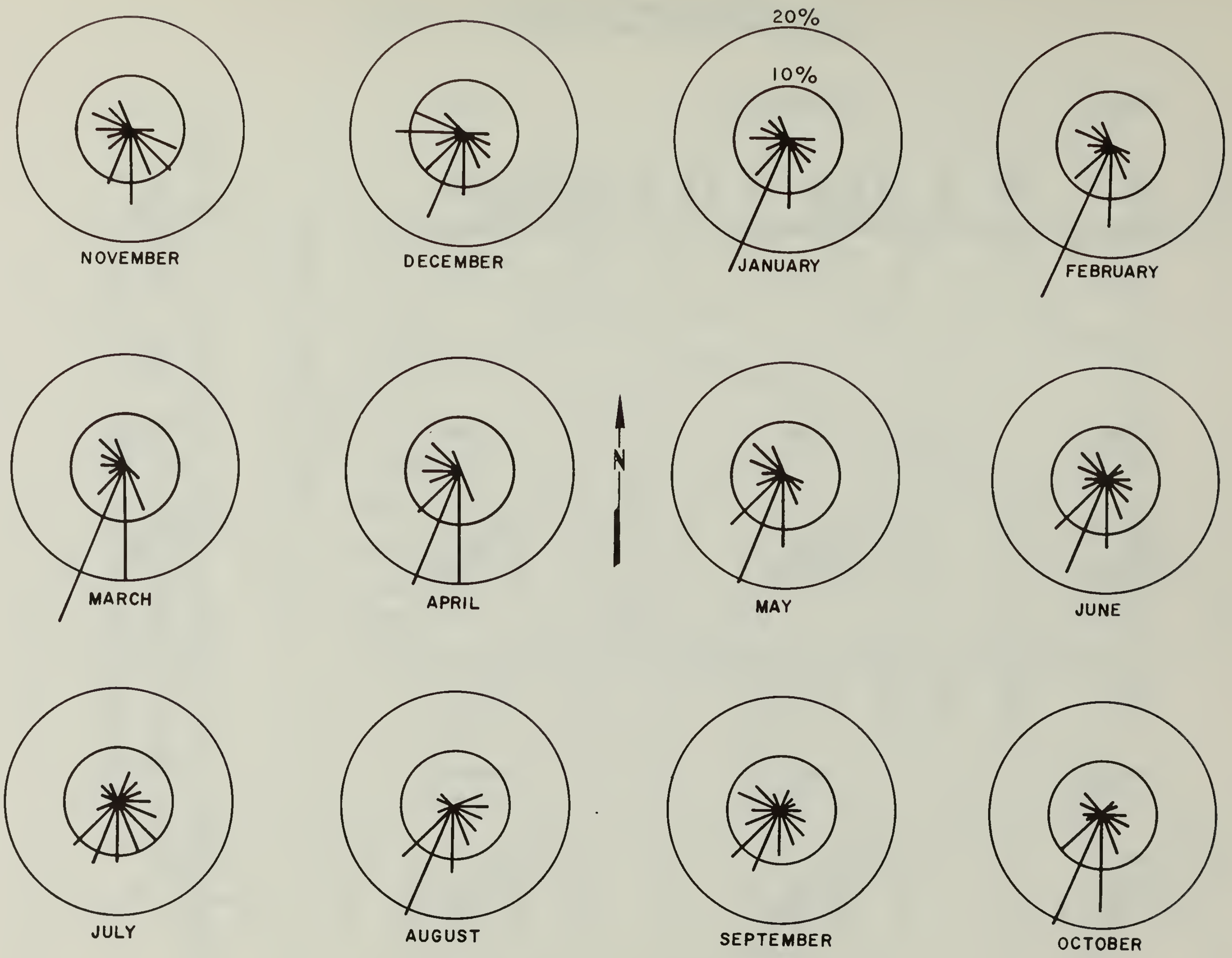


Figure II C-2 **STATION 023 30′ ELEVATION MONTHLY WIND ROSES**

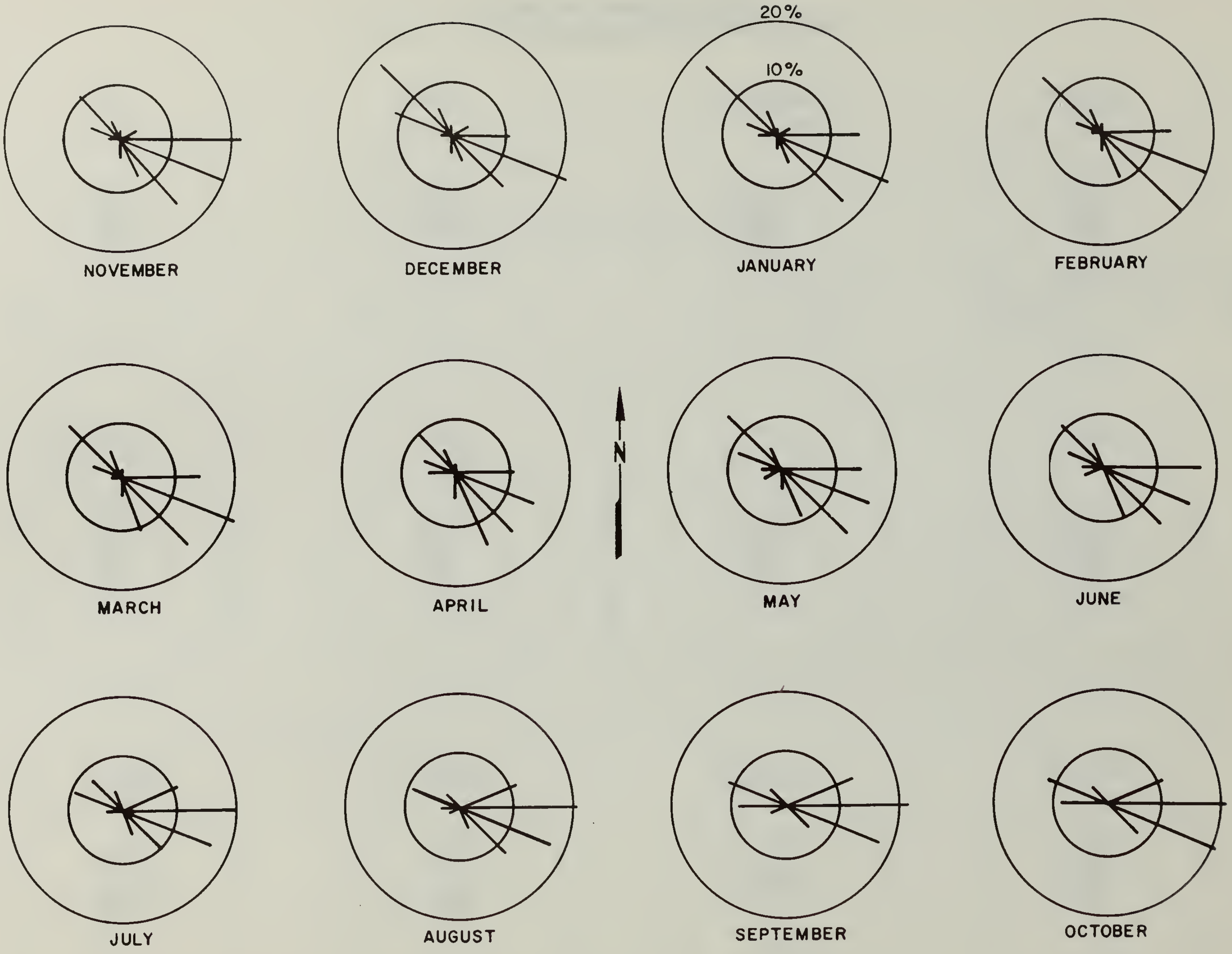


Figure II C-3 **STATION 021 30′ ELEVATION MONTHLY WIND ROSES**

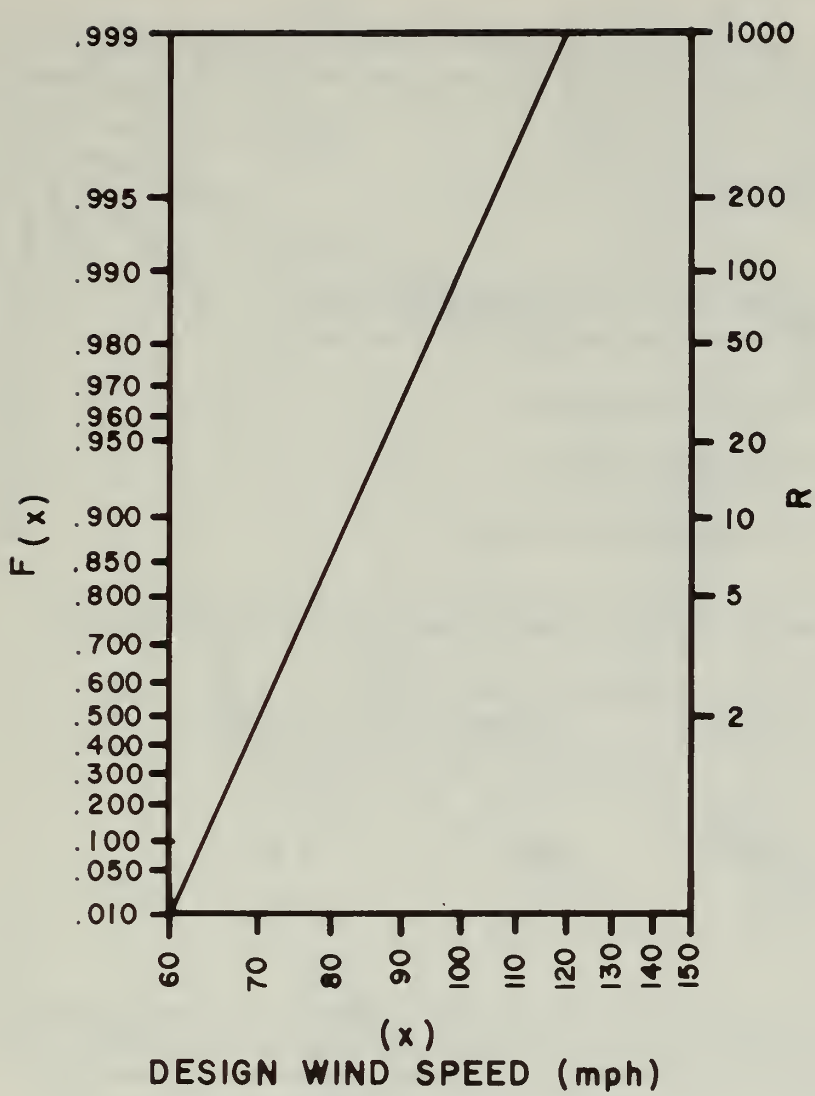


Figure II C-4. DESIGN WIND SPEEDS AS FUNCTIONS OF RISK AND RETURN PERIOD FOR THE C-b TRACT. (FRÉCHET DISTRIBUTION)

II C-2 Low Altitude Meteorology

The quarterly wind rose at the 100-foot level on the meteorological tower (Figure II C-5) indicates that the predominant wind direction is from the south-southwest for the June-to-August quarter, similarly to the previous quarter.

As reported in the previous quarterly report, the vertical variation of wind speed with height above the surface has been "fit" to a logarithmic equation of the form:

$$V(z) = \left(\frac{V^*}{k}\right) \ln (z/z_o)$$

Where

$V(z)$ = mean hourly wind speed at height z above the surface for the month

V^* = friction velocity

z_o = roughness length

k = von Karman's constant = 0.4

For the months of August through October the derived constants are:

Month	(V^*/k)	V^*(mph)	z_o(ft)
August	1.57	0.63	0.22
September	1.09	0.44	0.22
October	1.57	0.63	0.22

The solution of the vertical wind distribution in the planetary boundary layer was first obtained by Eckman in 1902 and is known as the Eckman spiral for which the horizontal components of wind direction are (Slade, 1968):

$$\bar{u}(z) = \bar{u}_G (1-e^{-az} \cos az)$$

and

$$\bar{v}(z) = \bar{u}_G e^{-az} \sin az;$$

where

$a = (f/2k_m)^{\frac{1}{2}}$

$f = 2\omega \sin\phi$ = Coriolis parameter

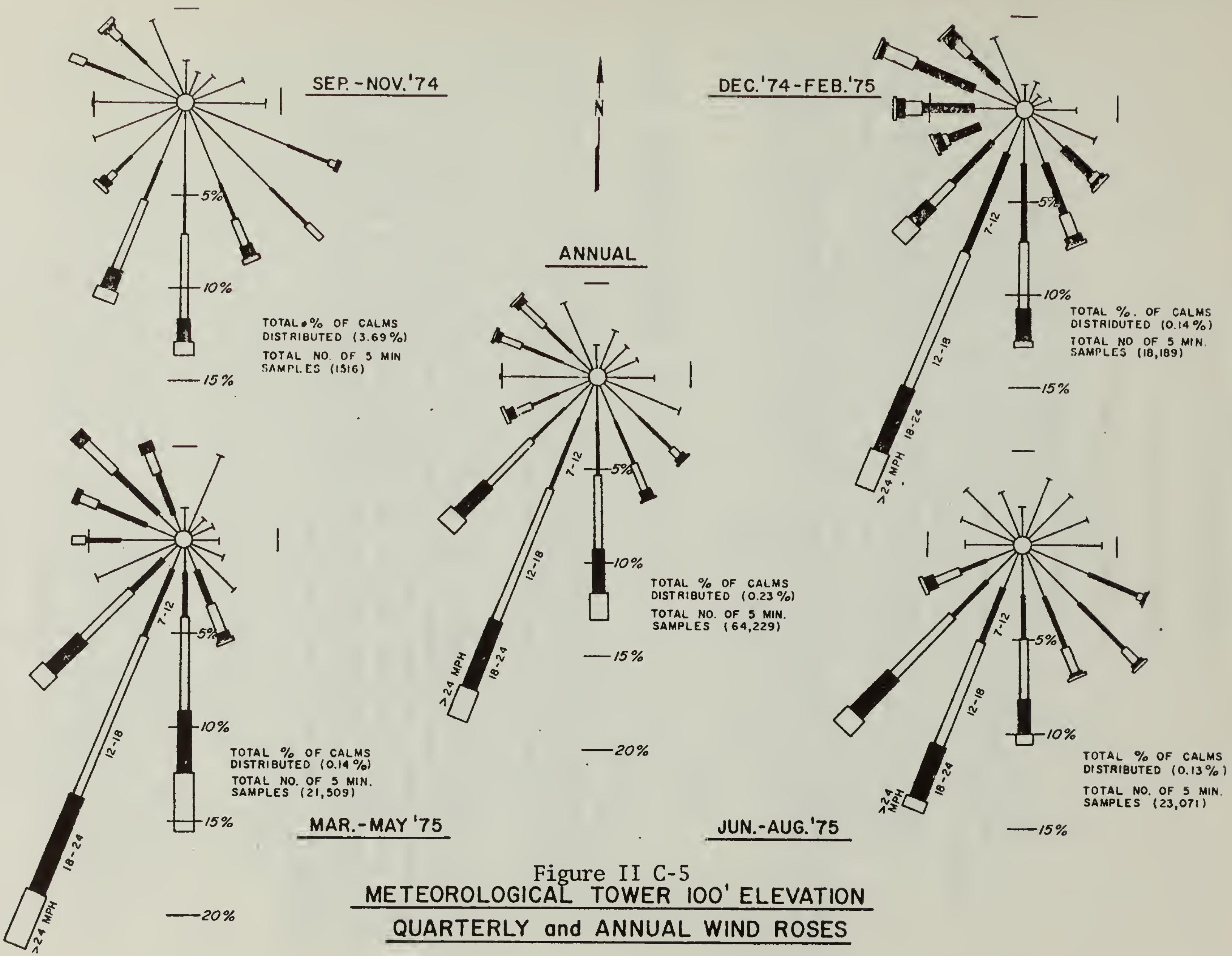


Figure II C-5
METEOROLOGICAL TOWER 100' ELEVATION
QUARTERLY and ANNUAL WIND ROSES

k_m = kinematic eddy - viscosity coefficient

ω = angular velocity of the earth

ϕ = geocentric latitude

$\bar{u}_G$ = geostrophic wind speed

$\bar{u}(z)$ = component of $\bar{u}_G$ along the x axis (i.e., the component along the geostrophic wind)

$\bar{v}(z)$ = component of $\bar{u}_G$ along the y axis

z_G = π/a= the lowest level at which $\bar{v} = 0$, i.e., the height of the top of the planetary boundary layer

The values of a, $\bar{u}_G$ and z_G have been found from the meteorological tower data as follows:

$$V(z)^2 = (\bar{u})^2 + (\bar{v})^2$$

where

V(z) is now referenced to the tower at heights z_1 and z_2,

so that

$$\frac{V(z_1)}{V(z_2)} = \frac{(1-2e^{-az_1} \cos az_1 + e^{-2az_1})^{\frac{1}{2}}}{(1-2e^{-az_2} \cos az_2 + e^{-2az_2})^{\frac{1}{2}}}$$

In this transendental equation the ratio of the wind speeds at any two levels of the tower is known and the constant, a, is unknown. This equation is most readily solved by assuming a range of a's to obtain the speed ratio, plotting the results and subsequently entering the plot at the appropriate value of speed ratio. Utilizing the 100 and 200 foot levels of the tower, the logarithmic profile yields a speed ratio of $\frac{V(100ft)}{V(200ft)} = 0.898$ which in turn yields

$$a = 12.7\times10^{-3} \text{rad./ft.}$$

and

$$z_G = \pi/a = 247 \text{ ft.}$$

For a typical month of July 1975

$$\frac{V^*}{k} = 1.26 \text{ mph}$$

$$V(100ft) = \frac{V^*}{k} \ln (100/0.22) = 7.70 \text{ mph}$$

$$\bar{u}_G = \frac{V(100ft)}{(1-2e^{-100a}\cos 100a+e^{-200a})^{\frac{1}{2}}} = 8.06 \text{ mph}$$

$$\bar{v} = 2.16 \text{ mph}$$

$$\bar{u} = 7.37 \text{ mph}$$

and the values for V, $\bar{v}$, $\bar{u}$, at 200 feet are 8.59, 0.36 and 8.58 mph, respectively. The calculated flow turn angle, $\alpha(=\tan^{-1}\bar{v}/\bar{u})$ from the 100 feet to 200 feet levels is 14 degrees (clockwise) which compares reasonably well with the annual average observed turn angle of 11 degrees.

Pasquill-Gifford stability class frequencies have been estimated for use in atmospheric diffusion studies for each hour of each month from temperature-difference data on the tower (200 ft. level minus 30 ft. level). Stability class frequencies by month are presented on Table II C-20. For the latest months, August-through-October, the highest frequency was that of the most unstable class, Class A. The second highest for all three months was that of the most stable class, Class F.

II C-3 Upper Air Studies

Inversion characteristics are reported from two acoustic sounders at Stations 021 and 023 respectively. Table II C-21 lists the number of inversions recorded and both means and standard deviations for inversion duration, maximum inversion heights on any given day, minimum inversion heights and average inversion heights for each operational month. Heights do not refer to bottom and top of the inversion layers but to the maximum and minimum heights of the top of the inversion layer for the duration of the inversion. July reported the highest number of inversions to date, but with the lowest inversion duration. Short duration is expected with rapid heating of the surface layer during the summertime. July's inversions were thicker on the average than for any other month. At the Rock School Site (021), the pooling of cool air in the valley creates longer lasting inversions which were somewhat lower in height than those on the plateau at site 023. Site 021 exhibited inversion formation times similar to those of site 023 but dissipation times were later during the summer as a result of the higher sun angle required to expose and heat the surface in the valley bottom.

The portion of the upper air studies dealing with winds aloft as obtained from pibal releases and with temperature profiles obtained from aircraft has been terminated upon written approval of the Area Oil Shale Supervisor. Additional correlation studies between the aircraft and the acoustic sounder data and a "representativeness" study of the 15-days of aircraft data per quarter utilizing continuous sounder data are underway.

TABLE II C-20METEOROLOGICAL SUMMARY: STABILITY CLASS FREQUENCIES (%)
1974-1975

Source: Met. Tower
(30' to 200')

Pasquill-Gifford Stability Class	dT/dz Range for this Stability Class (°C/100m)	Month												Annual
		Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	
A	<− 1.9	2.0	17.4	12.5	6.3	45.4	48.4	57.2	42.9	75	35.8	33.0	39.3	34.6
B	−1.9 to −1.7	0.4	1.3	2.7	1.5	6.5	4.1	3.1	4.6	2.5	4.4	3.4	3.1	5.0
C	−1.7 to −1.5	0	1.5	3.8	0.7	6.5	3.9	2.8	4.4	0	2.2	2.8	4.8	2.8
D	−1.5 to −0.5	5.3	19.0	22.6	33.7	27.0	20.6	12.3	16.1	0	7.5	8.0	11.7	15.3
E	−0.5 to +1.5	62.8	40.3	31.5	41.8	14.1	17.7	12.2	17.7	0	15.1	23.5	18.7	24.6
F	>1.5	29.5	20.5	26.9	16.0	0.5	5.3	12.4	14.3	0	35.0	29.3	22.4	17.7
Total		100	100	100	100	100	100	100	100	100	100	100	100	100

TABLE II C-21. Means and standard deviations of inversion durations and maximum, minimum, and average inversion heights by month as obtained from acoustic sounders.

Site	Month	Number of Operational Days	Number of Inversions Recorded	Inversion Duration(hrs.)		Maximum Inversion Heights(ft.)		Minimum Inversion Heights(ft.)		Average Inversion Heights(ft.)	
				Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
023	December	25	19	16	11	1207	461	421	277	796	332
	January	30	24	14	7	1417	354	604	366	1019	386
	February	28	25	12	4	1467	358	383	157	925	239
	March	27	28	6	3	1383	485	693	371	1028	442
	April	21	28	4	3	932	370	468	223	686	266
	May	29	26	5	3	884	347	457	192	673	263
	June	0		(no measurements were made in June)							
	July	15	33	3	2	1760	709	764	400	1202	483
	August	11	11	6	4	1414	508	555	369	945	436
	September	14	16	10	5	1029	291	242	113	559	166
021	August	5	30	6	3	1345	446	601	345	1022	334
	September	9	10	6	4	1251	298	490	240	915	183

II C-4 Visibility Study

The Environmental Stipulations have no specific requirement for a visibility monitoring program; however, the C-a and C-b Oil Shale Projects and the Area Oil Shale Supervisor have recognized the need for a program which will document the visibility and expand the scope of the air-quality monitoring program.

Visibility measurements, though not yet capable of defining or measuring levels of specific atmospheric pollutants, are none-the-less good general indicators of the purity of air. Visibility is also probably the most frequently used layman tool for defining air quality and the only parameter of air-quality measurements which is easily understood or recognized by the general public.

The objectives of this program are to document the visibility in the area of the Piceance Creek Basin and identify trends or variations in visibility which may be evident during the year-long monitoring program. Progress reports, made quarterly, present the results of monitoring in each of the four seasons, beginning with the fall of 1975. The results of this program provide baseline visibility data against which future data may be compared and with which concurrent meteorological and air quality data may be incorporated for further evaluation and consideration.

The method employed incorporates the technique of photographic photometry to measure the attenuation of light by atmospheric scattering. Unlike the integrating nephelometer which relies on the analog response of a photoelectric detector to record light attenuation, photographic photometry employs photographic film as the recording medium. Photographic measurements of the attenuation of light by atmospheric scattering have been made for many years in various ways and for different reasons. The technique used is one method of turbidity measurement and has been applied to turbidity of water as well as turbidity of air. It has been demonstrated that a camera can be used as an instrument for the measurement of visual range (visibility) and that a camera has certain advantages over the human eye: (1) a film provides a permanent record, (2) relative light intensities can be measured accurately, (3) a film can be calibrated for its reaction to light, (4) the camera eliminates "remembered" responses that may be an influence in human observers, (5) the camera, if maintained in good condition, does not experience focus changes, fatigue or deterioration in its repeatability, and (6) a telephoto lens allows measurements through long atmospheric path lengths.

Basically, the theory states that if a black object of sufficient size is moved through the atmosphere away from an observer, the brightness appears to increase. This apparent increase in brightness is the result of atmospheric light being scattered toward the observer by small aerosol particles suspended in the column of air between the object and the observer. If the same object were moved away from the observer through a vacuum (receiving the same illumination always), it would remain black and would disappear only when the resolving power of the eye could no longer enable the observer to distinguish it. This effect demonstrates the attenuation of light through air that contains particulate matter; and it is this effect that is detected in photographic measurements of visual-range.

The term visual-range is used rather than visibility when referring to a calculated distance of sight along a single path length. As a dark object is moved through the atmosphere toward the horizon sky, the contrast between the object and the sky decreases. At some distance the contrast becomes too small to be detected by the observer, and the object vanishes. The distance from the observer to the object at the vanishing point is the visual-range. It is a mathematically definable quantity capable of being measured, requiring no unattainable or unrealistic assumptions.

Visibility is a rather subjective term that in common usage has the connotation of a general state of clarity of the air. Visibility could be defined as the farthest distance that any object of suitable size can be identified visually without the aid of magnifying instruments. Still the concept suffers because of the multitude of variables allowed within the definition. Therefore, more limited concept of visual-range is used and defined in measureable quantities, leaving the term "visibility" to refer subjectively to the gross property of "being able to see" in all directions for a specified average distance.

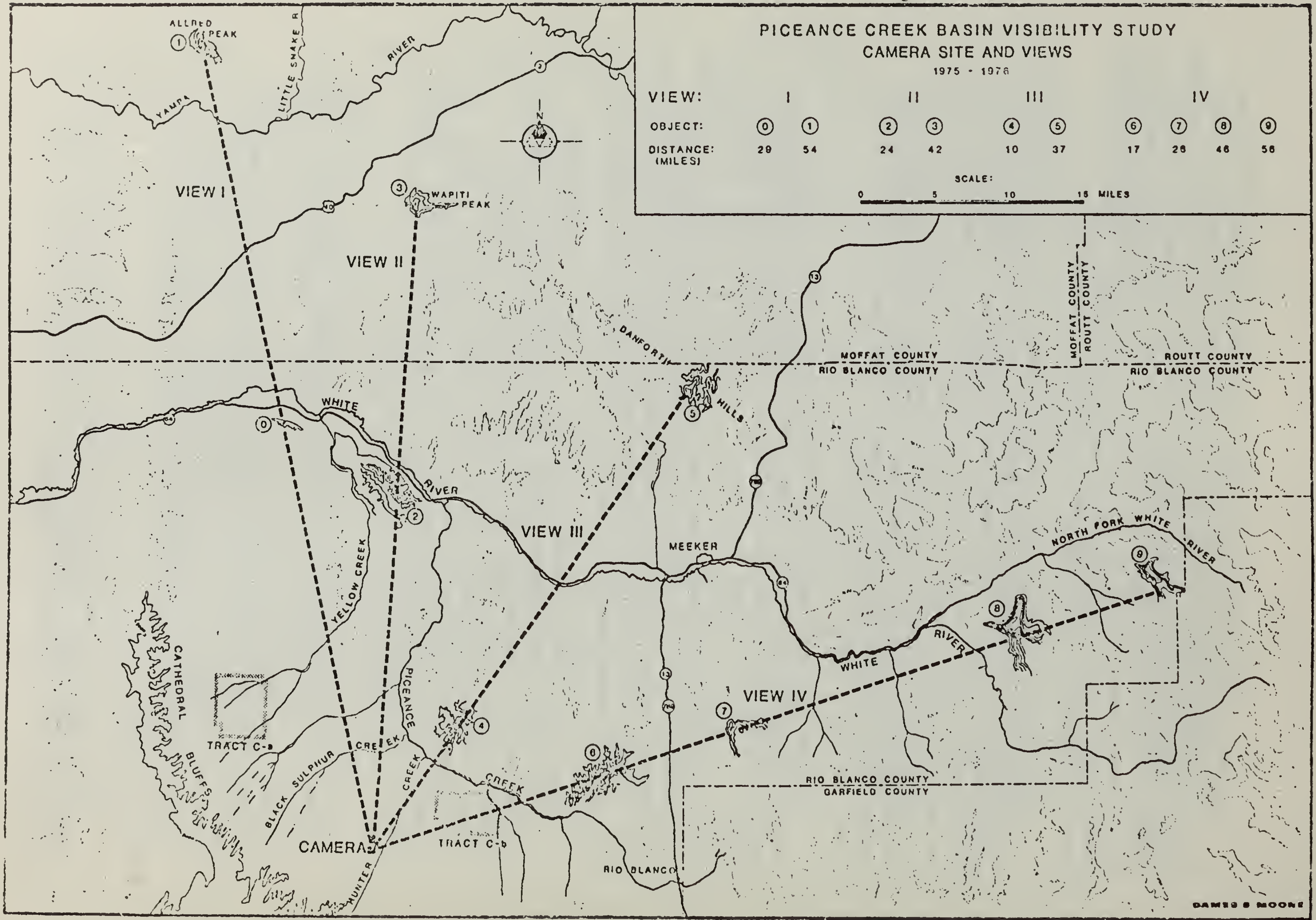
Data are collected by photographing several objects, such as mountains or ridges, in each of four views which scan the horizon from the north-northwest to the east-northeast. These views were chosen to ensure that any directional variation in visibility which might occur could be evaluated. The use of at least two objects in each view enables the calculation of a visual-range under a variety of visibility conditions. If inclement weather or other restrictions to visibility obscure the most distant object, visual-range measurements can still be made with a less distant object. The minimum calculable visual-range, however, is dictated by the availability of suitable objects near the camera site.

Although it would have been desirable to incorporate additional views and objects describing a larger portion of the horizon, the geographic nature of the area prohibited the use of additional views. The location of the views used in this study and their orientation to Piceance Creek and Tracts C-a and C-b are shown in Figure II C-6. Measurements were obtained during the months of September, October and November, 1975 and represent the fall, 1975 monitoring period. Approximately 300 measurements were obtained and used in the statistical analysis of visual-range during the fall quarter.

During the fall quarter, visual-ranges were generally quite high; ninety-five percent of the visual-range measurements were greater than 45 miles, 50 percent were greater than 93 miles. Pertinent statistics for each individual view and the composite of all four views are given in Table II C-22. Maximum visual-ranges obtained during this period varied little from view to view; minimum visual-ranges varied among the views only slighlty more than the maximum values. The mean visual ranges of the four views during the fall quarter appear relatively uniform, with the exception of View II, which had the lowest visual-range of views.

For purposes of describing the general state of visibility independent of direction, a composite distribution of all visual-range measurements during the fall quarter is presented in Figure II C-7.

Figure II C-6


PICEANCE CREEK BASIN VISIBILITY STUDY
CAMERA SITE AND VIEWS
1975 - 1976
VIEW: I II III IV
OBJECT: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
DISTANCE: (MILES) 29 54 24 42 10 37 17 28 46 56
SCALE: 0 5 10 15 MILES
ALLRED PEAK
WAPITI PEAK
YAMPA
LITTLE SNAKE R
RIVER
VIEW I
VIEW II
VIEW III
VIEW IV
DANFORTH HILLS
MOFFAT COUNTY
RIO BLANCO COUNTY
ROUTT COUNTY
GARFIELD COUNTY
WHITE RIVER
NORTH FORK WHITE RIVER
MEEKER
YELLOW CREEK
PICEANCE CREEK
BLACK SULPHUR CREEK
HUNTER
CATHEDRAL BLUFFS
TRACT C-a
TRACT C-b
RIO BLANCO
CAMERA
N
DAMES & MOORE
PLATE 1

Visual-ranges during this quarter occurred most frequently between 100 and 110 miles, although visual-ranges between 40 and 60 miles accounted for approximately 20 percent of the measurements.

The generalized visibility in the Piceance Creek Basin area during the fall quarter was 91 miles. To adequately distinguish the mean visual-range for an individual view from than mean value for all views during a season, the term generalized visibility has been chosen to represent the composite mean visual-range. The generalized visibility is used to describe the areal visibility while reserving the term visual-range for a single path length.

An evaluation of visual-ranges in each of the three fall months indicated that the monthly mean visual-range increased an average of approximately 13 percent per month. The tendency for visibilities to increase during the cooler months of the year is not uncommon. Visual-ranges were generally higher in November than the previous two months, and had larger fluctuations, as evidenced by the maximums, minimums and standard deviations, presented in Table II C-22b.

Daily mean visual-ranges fluctuated considerably during the fall quarter; variations of 30 to 40 miles during the period of a week were not uncommon. Moreover, fluctuations in the daily mean visual-range of the four views were closely correlated.

The mean hourly ranges for each view and for all views combined are presented in Figure II C-8 for each hour of photography. The mean visual-range in Views I and II exhibit similar changes each hour of the day. The mean visual-range begins low in the morning, experiences an initial peak during mid-morning, then drops before noon. During the afternoon, the mean visual-range climbs steadily until reaching a maximum at 1500 hours.

The mean hourly visual-range in Views III and IV also exhibits similar changes. All views experienced a morning peak in visual-range, although the eastern views experience it an hour later, a definite decrease in visual-range after this peak and a steady afternoon increase to the maximum visual range at 1500 MST. It is also interesting to note the delayed afternoon minimum visual-range in View IV. The composite trend, shown in Figure II C-8 also illustrates trends common to all views: a morning peak, followed by a decline in visual-range, and a maximum mean visual-range occurring at 1500 MST.

II C-5 Noise

Monthly noise measurements are made at the 14 locations cited on Figure II C-7 of Quarterly Summary Report #4 utilizing a General Radio 1565-B sound-level meter. Data for this reporting period cover the months of September through November 1975 and are contained in Quarterly Data Report #5. These data are for the most part "uneventful", in that the bulk of the measurements border on the minimum detectable level of the instrument.

TABLE II C-22.

(a) VISUAL-RANGE SUMMARY (MILES)
PICEANCE CREEK BASIN, COLORADO
FALL, 1975

VIEW	MEAN	MAXIMUM	MINIMUM	5 PERCENTILE	STANDARD DEVIATION
I	93	149	37	49	27.8
II	77	142	42	43	23.6
III	92	146	24	46	27.4
IV	101	148	48	52	25.8
Composite	91	149	24	45	27.3

(b) VISUAL-RANGE (MILES) STATISTICS FOR ALL VIEWS COMBINED FOR EACH MONTH OF MONITORING PICEANCE CREEK BASIN, COLORADO
FALL, 1975

MONTH	MEAN	MAXIMUM	MINIMUM	STANDARD DEVIATION
September	77	131	42	24.0
October	89	144	44	24.6
November	99	149	24	29.0

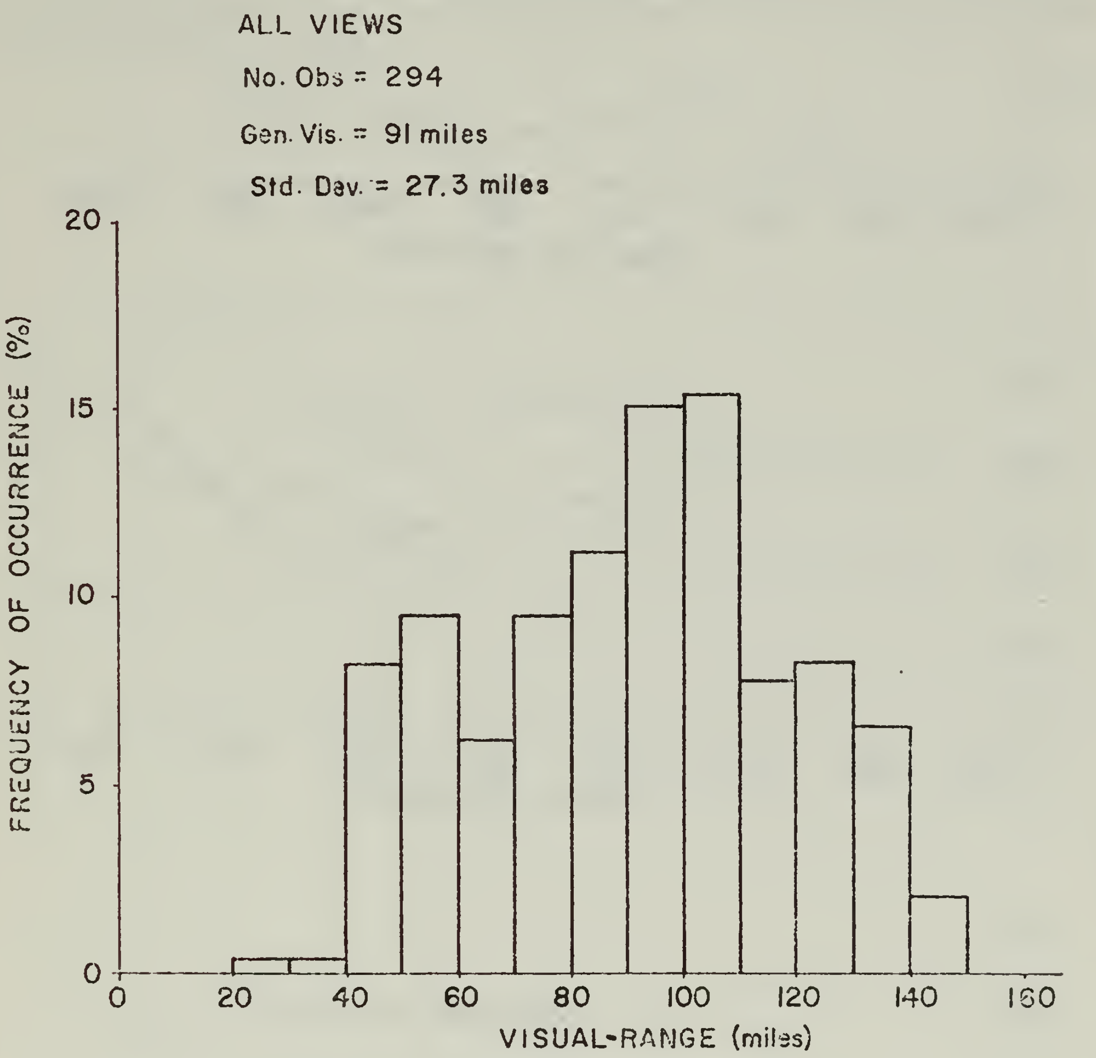


FIGURE II C-7

COMPOSITE VISUAL-RANGE DISTRIBUTION
PICEANCE CREEK BASIN, COLORADO
FALL, 1975

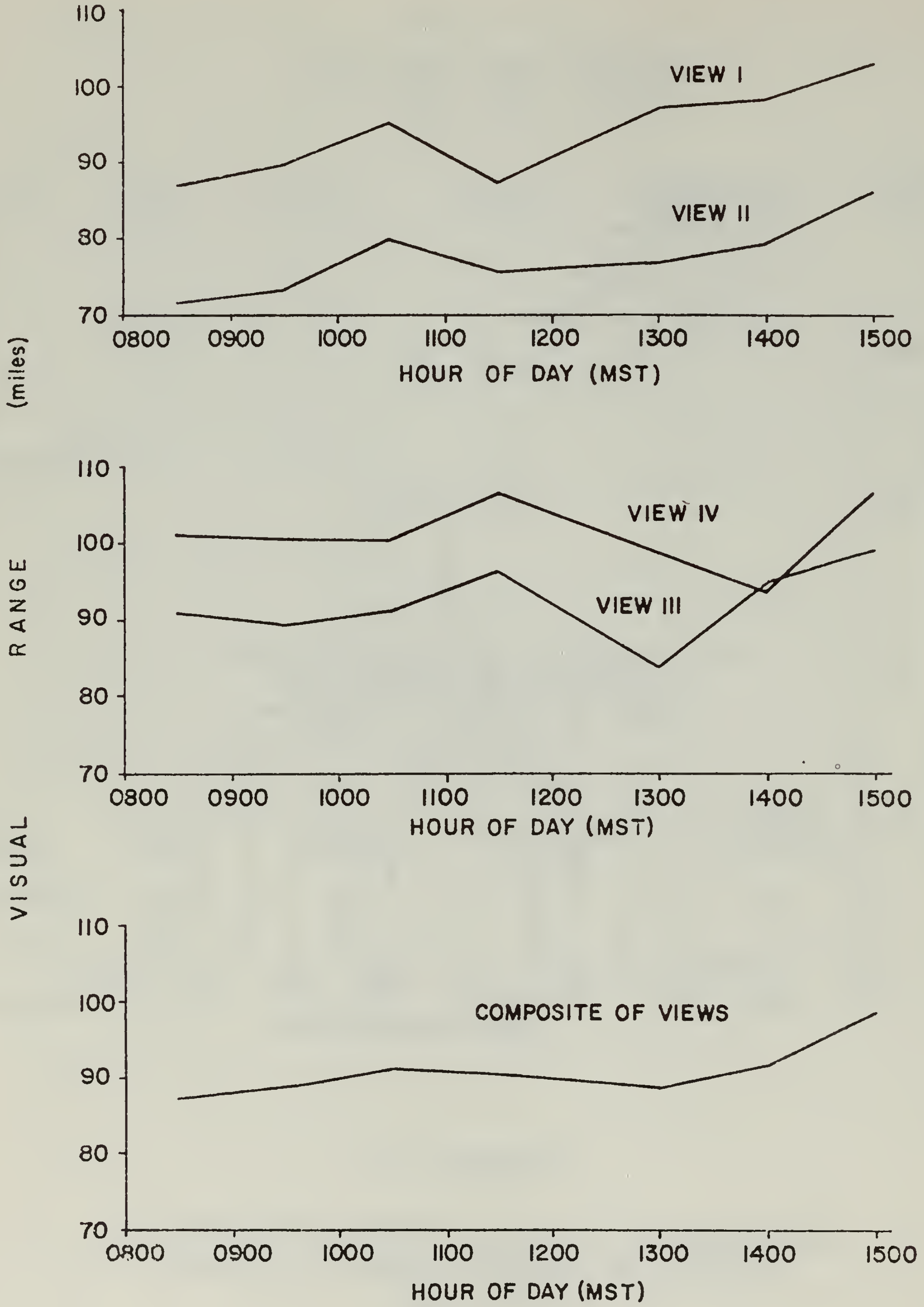


FIGURE II C- 8

VARIATION IN THE MEAN HOURLY VISUAL-RANGE
PICEANCE CREEK BASIN, COLORADO
FALL, 1975

DAMES & MOORE

II C-6 Atmospheric Diffusion Studies

No additional modeling studies have been undertaken beyond the Phase I studies of the previous summary report.

Correlations between the aircraft data, the acoustic sounder data and temperature difference data on the meteorological tower are being attempted to obtain hourly estimates of mixing layer height during the baseline period.

II D BIOLOGY

The biological studies in this quarter are discussed in the following sections:

II D-1 Terrestrial Wildlife Studies

Big Game; Medium-Sized Mammals; Small Mammals; Avifauna; Amphibians and Reptiles; and Arthropods

II D-2 Aquatic Studies

Fish; Benthos; Periphyton; Primary Production; Water Quality; Sediment Analyses; and Springs and Seeps

II D-3 Terrestrial Vegetation Studies

Vegetation Mapping; Phytosociological Sampling; Productivity Studies; Decomposition and Litter Studies; and Successional Studies

II D-4 Dendrochronology and Dendroclimatology

II D-5 Soil Survey

II D-1 Terrestrial Wildlife Studies

Big Game

During this quarter the following tasks were performed: 1) study of the fall migrational movements of mule deer; 2) initiation of the fall-spring deer road counts; 3) continuation of the photographic record of deer-carcass decomposition; 4) September predator, scent-post survey; and 5) bimonthly track counts of deer and medium-sized mammals (September and November).

To more clearly define the timing, duration and intensity of deer influx into the Tract C-b area from the summer range to the south, transects were established on major north-south ridges in and around the Tract. These ridges are set off by the major valleys in the area which include Willow and Piceance Creeks, Scandard, Sorghum, Middle Stewart and West Stewart Gulches. Surveys of the ridges revealed that movement into the area is rapid with a large proportion occurring over a 7-10 day period.

Road counts along a 36-mile stretch of County Highway 5 from Little Hills Game Experiment Station to Rio Blanco during this quarter resulted in no deer observed on September 27, 1975. Numbers of deer present in the agricultural meadows increased during counts conducted in October and November. (Table II D-1). The largest number of deer recorded was 343 on November 10. An age-class determination on November 21 indicated a fawn-doe ratio of 113 fawns to 100 does.

Deer mortality investigations were initiated again this quarter. Photographic records of known-age deer carcasses were continued in order to document rates of tissue deterioration. This information will facilitate assessing the age of carcasses in subsequent studies.

Medium-Sized Mammals

The standard coyote scent-post survey was conducted on September 26. An index of 122 was obtained. Bimonthly track counts conducted during September and November revealed tracks of coyotes and cottontail rabbits (Table II D-2).

Small Mammals

During the fifth quarter of study, eleven small mammal species were live-trapped in and around Tract C-b (Table II D-3). No new species were captured during this survey period. Population estimates for the two most abundant species (deer mouse and least chipmunk) during this period at Grids 1 and 2 and comparisons with past estimates show that peaks were reached in August. These peaks are probably the result of recruitment to the population of young animals.

Trapping results at the nine satellite grids show similar trends as observed at Grids 1 and 2. The deer mouse and the least chipmunk are the most abundant small mammals at the satellite grids. Vole populations, which remained low through the spring and summer months, were beginning to increase during this quarter.

Indices of Reproductive Success

An examination of female reproductive systems from May to September revealed that the mean number of embryos per female for the deer mouse was 5.0 (Grid 1) and 5.2 (Grid 2). Mean embryo number in the least chipmunk was 5.5 (Grid 1). Placental scars in female deer mice averaged 12.0 (Grid 1) and 6.7 (Grid 2). The average number of placental scars in female least chipmunks was 6.2 on Grid 1.

Biomass

Biomass values for the deer mouse and least chipmunk were determined in September (Table II D-4). In Grid 1, 51.5 gm/acre of deer mice

TABLE II D-1 MULE DEER ROAD COUNTS CONDUCTED OCTOBER-NOVEMBER 1975 NEAR TRACT C-b

Mile Interval		Location	Number of Deer										
			October					November					
			17	19	24	28	29	5	6	10	21	23	Totals
1		Little Hills											
2									2			11	13
3							1		6				7
4								3	3	7		11	24
5												1	1
6										11			11
7									7		6		13
8									3				3
9		Ryan Gulch							1			3	4
10								1	3	4	6	14	28
11													0
12		Black Sulphur Creek				5	21	15	17	6		3	67
13				9	3	7	15	15	27	25		3	104
14		Hunter Creek			15	2	6	7	3	5		9	47
15			2				4	7	36	4		3	56
16	Tract C-b	Willow Creek	21		7	49					4	17	98
17			16	100	8	49		30	40	69	13	23	348
18		Sorghum Gulch	91	108	6	4	76	192	56	152			685
19				5			18	12	13	17			65
20		Stewart Creek			6		16	32	4	22	3		83
21							7	11	18	7			43
22					5				17	11			33
23				15				13		3			31
24													0
25		Story Gulch						4	7				11
26				5					3		4		12
27													0
28													0
29				1									1
30													0
31													0
32													0
33													0
34													0
35													0
36		Rio Blanco											0
		Totals	130	243	50	116	164	342	266	343	36	98	1788

TABLE II D-2 PRECENT FREQUENCY* OF TRACKS FROM COUNTS CONDUCTED 30 SEPTEMBER AND 20 NOVEMBER 1975

Habitat Type	No. of Quadrats		Deer		Coyote		Cottontail	
	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.
Pinyon-juniper woodland	19	100	10	21	0	1	21	3
Chained pinyon-juniper	21	100	0	27	0	0	9.5	1
Valley Sagebrush	18	100	0	18	0	1	72	3
Lower valleys and agricultural meadows	17	100	0	21	29	2	24	3

---

*Percent frequency = No. of quadrats with tracks ÷ total no. of quadrats in each habitat type.

TABLE II D-3 SMALL MAMMALS TRAPPED ON TRACT C-b IN AUGUST, SEPTEMBER, AND NOVEMBER, 1975

Scientific Name	Common Name	August 1975			September 1975			November 1975
		Satellites	Site 1	Site 2	Satellites	Site 1	Site 2	Satellite Grids
RODENTIA								
Sciuridae								
Spermophilus lateralis	Golden-mantled ground squirrel	x	x	x	x	x	x	
Eutamias minimus	Least chipmunk	x	x	x	x	x	x	
Eutamias quadrivittatus	Colorado chipmunk			x	x		x	
Heteromyidae								
Perognathus apache	Apache pocket mouse	x	x		x	x		
Cricetidae								
Lagurus curtatus	Sagebrush vole	x			x	x		x
Microtus montanus	Montane vole	x	x	x	x	x		
Microtus sp.	Vole	x						
Neotoma cinerea	Bushy-tailed wood rat	x		x		x	x	
Peromyscus maniculatus	Deer mouse	x	x	x	x	x	x	x
Peromyscus truei	Pinyon mouse					x		
Zapus princeps	Western jumping mouse	x			x			

TABLE II D-4 LIVE WEIGHT ESTIMATES OF SMALL MAMMALS TRAPPED ON GRIDS 1 and 2 DURING SEPTEMBER 1975

	Deer Mouse (*Peromyscus maniculatus*)	Least Chipmunk (*Eutamius minimus*)	Colorado Chipmunk (*Eutamius quadrivittatus*)
GRID 1			
ADULT MALES			
Number Trapped	8	16	-
Mean Weight, $\bar{x}$, grams	15.5	32.7	-
Range	11-21	30-36	-
Standard Deviation	3.9	1.9	-
95% Confidence Interval	$\bar{x} \pm 3.4$	$\bar{x} \pm 1.0$	-
ADULT FEMALES (Non-reproductive)			
Number Trapped	6	5	-
Mean Weight, $\bar{x}$, grams	14.5	33.6	-
Range	12-21	30-37	-
Standard Deviation	3.6	2.5	-
95% Confidence Interval	$\bar{x} \pm 3.8$	$\bar{x} \pm 3.1$	-
ADULT FEMALES (Reproductive)			
Number Trapped	5	-	-
Mean Weight, $\bar{x}$, grams	19.4	-	-
Range	14-29	-	-
Standard Deviation	5.8	-	-
95% Confidence Interval	$\bar{x} \pm 7.2$	-	-

TABLE II D-4 (continued)

	Deer Mouse *(Peromyscus maniculatus)*	Least Chipmunk *(Eutamius minimus)*	Colorado Chipmunk *(Eutamius quadrivittatus)*
GRID 2			
ADULT MALES			
Number Trapped	17	1	1
Mean Weight, $\bar{x}$, grams	14.3	24	50
Range	9.5-21.0	-	-
Standard Deviation	3.4	-	-
95% Confidence Interval	$\bar{x} \pm 1.7$	-	-
ADULT FEMALES (Non-reproductive)			
Number Trapped	11	-	-
Mean Weight, $\bar{x}$, grams	13.5	-	-
Range	9-20	-	-
Standard Deviation	3.1	-	-
95% Confidence Interval	$\bar{x} \pm 2.1$	-	-
ADULT FEMALES (Reproductive)			
Number Trapped	1	-	-
Mean Weight, $\bar{x}$, grams	21	-	-
Range	-	-	-
Standard Deviation	-	-	-
95% Confidence Interval	-	-	-

were present. Individual weights suggested that many deer mice were subadult animals new to the population. Total biomass for Grid 2 was 27.7 gm/acre of deer mice. The individual weights suggested that these animals were also subadults and new to the population.

Least chipmunk biomass at Grid 1 was 112.3 gm/acre, approximately 100 percent greater than deer mouse biomass. No chipmunks were captured or weighed at Grid 2 during September.

Rodent Diets

Stomach samples examined during this quarter were for deer mice captured in September. These analyses revealed that deer mice increased their consumption of seeds, and the relative frequencies of arthropods and green vegetation in the diet decreased. These data support the hypothesis that the deer mouse is an opportunistic feeder and utilizes food sources as they become available.

Avifauna

The major objective of the bird censuses conducted during the fifth quarter was to determine the early-fall composition of avian communities on and close to the Tract. Both qualitative and quantitative data were gathered and analyzed in a manner consistent with the previous field studies.

During September, censusing was accomplished by Emlen strip procedures (Emlen, 1971) along the eight standard sampling transects. Data were used to calculate estimates of densities of songbird species utilizing Tract habitats. Thirty-one species were recorded on the eight transects; 23 of these were passerines, two were hawks, two were woodpeckers and one each of the following: duck, eagle, dove and nighthawk. Clark's nutcracker was the most ubiquitously distributed species occurring in low numbers along seven of the eight transects. Transect 8 (mountain shrub) had the fewest species (4) while Transect 4 (pinyon-juniper woodland) contained the most (16) and achieved the highest recorded density (24.3 birds/ha). The chained pinyon-juniper rangeland at Transect 6 had the second highest number of species (12) and the second highest density (13.5 birds/ha). Species present in greatest densities included vesper sparrow, Brewer's sparrow, red-winged blackbird, song sparrow and green-tailed towhee.

Qualitative observations were made throughout Tract habitats including "edge" habitats and small areas of vegetative mixtures which are unusual for the Tract region. These observations accounted for 28 species including eight which were not encountered during the quantitative transect counts. The species most frequently observed during qualitative counts were red-winged blackbird, mountain blue-bird, Brewer's blackbird, black-billed magpie and chipping sparrow.

Eleven separate counts of waterfowl and shorebirds utilizing the two observation impoundments documented the presence of seven species including six which were not seen on strip transects or during qualitative counts. These were green-winged teal, blue-winged teal, mallard, northern shoveler, pintail, solitary sandpiper and lesser yellowlegs. Lesser yellowlegs had not previously been observed during field investigations on or near the Tract.

Eighty-two individuals of nine raptorial species were observed during the early-fall field investigations. In decreasing order of relative abundance the most common were the common raven, American kestrel and red-tailed hawk. The golden eagle, American kestrel, red-tailed hawk, turkey vulture, common raven, marsh hawk, Cooper's hawk and prairie falcon were the diurnal species noted, while the great horned owl was the only nocturnal bird-of-prey species observed.

No additional raptor nest sites were discovered during the late spring and summer census periods. All active raptor nests previously encountered on the Tract were described in Quarterly Data Report #3. Sixty-six raptor pellets were collected from active nesting sites and roosting stations during October and these were analyzed during this reporting period (Table II D-5). Pellets were predominantly from common ravens, but kestrel and great horned owl pellets were also represented in the collections. Pellet analysis proved that microtines were the major mammalian prey item; insects also figured importantly in the food of ravens and kestrels.

Including observations from transects, qualitative counts, waterfowl tallies and raptor counts, 51 species were noted in the study area during September. Five of these (sage grouse, greater sandhill crane, lesser yellowlegs, Townsend's warbler and yellow-headed blackbird) had not previously been observed during field investigations of the Tract C-b region.

Reptiles and Amphibians

No amphibians were observed during this survey period and only two sagebrush lizards were captured. Temperature during this period is generally low enough to inhibit or greatly curtail lizard and amphibian activity.

Arthropods

Arthropods representing 2 classses, 14 orders and 56 families were identified from collections on Tract C-b in August and September of 1975. These totals represent a faunal diversity similar to that observed in September of 1974. In the month of August the diversity of arthropod fauna from pit-can traps was much lower on the pinyon-juniper site than

TABLE II D-5

ANALYSIS OF RAPTOR PELLETS COLLECTED AT TRACT C-b DURING OCTOBER 1975

Raptor Species	Total Number of Pellets	Prey Species Represented	Number Prey Species	% Relative Abundance*
Common raven	42	*Microtus* spp.	42	49.4
		Peromyscus spp.	6	7.1
		Thomomys talpoides	2	2.3
		Sylvilagus sp.	1	1.2
		Orthoptera (grasshoppers)	30	35.3
		Coleoptera (beetles)	4	4.7
		TOTAL	85	
American kestrel	11	Orthoptera (grasshoppers)	8	66.7
		Coleoptera (beetles)	1	8.3
		Miscellaneous insects	3	25.0
		TOTAL	12	
Great horned owl	8	*Microtus* spp.	10	83.3
		Thomomys talpoides	2	16.7
		TOTAL	12	
Red-tailed hawk	1	*Peromyscus* sp.	1	100.0
		TOTAL	1	

---

*Percent Relative Abundance was calculated as:

$$\% \text{ Relative Abundance} = \frac{\text{Number individuals of species A}}{\Sigma \text{ number individuals of all species}} \times 100$$

that on the chained pinyon-juniper. Analysis of data from the pit-can traps indicates that the chained pinyon-juniper supported a diversity of arthropod fauna similar to that found in the pinyon-juniper during the month of September.

The relative abundance of arthropods was compared in the two major vegetation types and among the three common shrubs found on Tract C-b. The relative abundance of arthropods was found to vary somewhat with the species of shrub; sampling was by sweep netting during the August and September sampling period. It appears that serviceberry (*Amelanchier alnifolia*) and mountain mahogany (*Cercocarpus montanus*) both supported approximately similar arthropod populations in terms of relative abundance and diversity. However, big sagebrush (*Artemesia tridentata*) supported greater numbers of arthropods than the other two shrub species in the current sampling period.

II D-2 Aquatic Studies

The aquatic studies for this quarter included fish, benthos, periphyton, primary production, water quality, sediment and springs and seeps.

Fish

Fish were collected in September and November. Drifting ice in the White River hindered sampling in November. Species of fish collected included those caught in previous surveys. Brook trout were spawning in October and November.

Fecundity estimates were made for brook trout and mountain suckers. Brook trout examined produced from 978 to 1006 eggs, and mountain suckers produced from 7599 to 8699 eggs (Table II D-6). Population estimates were made for one station on Piceance Creek (Table II D-7). The estimate was 22 to 53 fish per 100-meter-reach of stream.

Stomach analyses indicated brook trout fed primarily on Dipterans and Ephemeropterans (aquatic insects) (Table II D-8).

Benthos

Benthic invertebrates were collected in September and November. Annelids, arthropods and molluscs were collected. The arthropods were the most numerous, represented by 9 orders and 46 taxa in September, 8 orders and 27 taxa in October and 8 orders and 27 taxa in November.

Benthic invertebrates were generally more abundant at upstream stations with the exception of Oligochaetes. Biomass values ranged

TABLE II D-6

FECUNDITY ESTIMATES FOR FEMALE BROOK TROUT AND MOUNTAIN SUCKERS COLLECTED FROM STEWART CREEK AND PICEANCE CREEK, SEPTEMBER AND NOVEMBER 1975

BROOK TROUT - SEPTEMBER

No.	Size (mm)	Weight (gm)	Total Weight Ovary	Subsample #1 Weight	Subsample #1 Number of eggs Large & Small	Subsample #1 Tot.	Subsample #1 Fecundity Estimate	Subsample #2 Weight	Subsample #2 Number of eggs Large & Small	Subsample #2 Tot.	Subsample #2 Fecundity Estimate	Subsample #3 Weight	Subsample #3 Number of eggs Large & Small	Subsample #3 Tot.	Subsample #3 Fecundity Estimate	Estimated Aver. No. Eggs
1.	225	215	5.5717	.2366	43	43	1,013	.3969	71	71	997	.3669	61	61	926	978
2.	297	387	4.9203	.5264	103	103	962	.4696	92	92	963	.3739	83	83	1,091	1,006

MOUNTAIN SUCKERS - NOVEMBER

No.	Size (mm)	Weight (gm)	Total Weight Ovary	Subsample #1 Weight	Subsample #1 Number of eggs Large & Small	Subsample #1 Tot.	Subsample #1 Fecundity Estimate	Subsample #2 Weight	Subsample #2 Number of eggs Large & Small	Subsample #2 Tot.	Subsample #2 Fecundity Estimate	Subsample #3 Weight	Subsample #3 Number of eggs Large & Small	Subsample #3 Tot.	Subsample #3 Fecundity Estimate	Estimated Aver. No. Eggs
1.	190	78.2	6.3719	.1906	200	200	6,686	.1779	247	247	8,845	.1465	243	243	10,568	8,699
2.	162	51.4	4.0201	.2864	473	473	6,636	.0999	473	473	6,800	.1039	242	242	9,362	7,599

TABLE II D-7 FISH POPULATION ESTIMATE FOR PICEANCE CREEK (STATION P-3) BASED ON SAMPLING IN SEPTEMBER 1975.

	Total Fish	Mountain Suckers	Brook Trout	Speckled Dace
Replicate:				
1	24	16	1	7
2	5	3	1	1
3	7	3	1	3
Totals	36	22	3	11
Computational Data[1]:				
T		23	2	11
$\sum_{i=1}^{k}(i-1)y_i$		10	2	7
R		0.434	1.0	0.636
$\hat{p}$		0.625	0	0.45
$(1-\hat{q}^k)$		0.94	0	0.825
Population Estimate $(\hat{N})$		24.4	0	13.3
95% Confidence Interval		17-32	0	5-21.7

$$\hat{N} = \frac{T}{(1-\hat{q}^k)}$$

k=3

$$\sum_{i=1}^{k} (i-1)y_i = y_2 + 2y_3$$

$$(1-\hat{q}) = (1-(1-\hat{p})^k)$$

TABLE II D-8 STOMACH CONTENT OF BROOK TROUT COLLECTED FROM STEWART CREEK, SEPTEMBER 1975

	Fish #1			Fish #2		
	Sex	Length	wt.	Sex	Length	wt.
Stomach Contents[1]	Female	297mm	387g.	Female	225mm	215g.
Diptera						
Tipulidae						
Tipula sp.					1	
Chironomidae		3			3	
Stratiomyiidae						
Odontomyia		1			1	
Anthiomyiidae						
Limnophora		21				
Ephemeroptera						
Baetidae					5	
Volume of stomach Contents (ml.)		2.0			3.0	

---

[1] Number of Individuals

from 0.0276 to 0.4793 gm/ft^2 in September and from 0.0094 to 0.5929 gm/ft^2 in November. Higher biomass values occurred at the middle sampling stations in Piceance Creek.

Most orders were decreasing in numbers by November. These shifts in abundance are attributed to seasonal changes which occur naturally.

Periphyton

Periphyton samples from September and November were analyzed for this period. Diatoms were the most abundant periphyton species. Green and blue-green algae and euglenids were also present. Experiments indicate greater colonization on horizontal substrates.

Primary Production

Periphyton primary productivity estimates were made from ash-free dry weights. The greatest periphyton primary production occurred at downstream stations.

Planktonic primary production was measured in the lakes with light and dark bottles in September and November. These analyses indicate that planktonic primary production was negligible. The low values may mean inhibition of production because of too much light in the shallow clear waters.

Water Quality

Water samples were analyzed for common minerals and nutrients, dissolved oxygen, pH, specific conductance, coliforms, streptococci and pathogens. Total dissolved solids decreased in September and November with increased flows caused by cessation of water diversion for irrigation and some fall precipitation. Highest levels of dissolved solids were at downstream stations. Inasmuch as cattle had returned to the meadows for winter by November, coliform levels increased at some stations. No pathogenic bacteria were identified during this quarter.

Sediment

Sediment samples were collected in September and November. September samples were analyzed for total Kjeldahl nitrogen, chemical oxygen demand, percent moisture and percent volatile solids. Sediment grain-size analyses were conducted in November. Silt levels were increasing in November compared to July samples.

Springs and Seeps

As part of the baseline studies springs and seeps in the vicinity of the Tract are being identified and examined. Some of the major springs are incorporated into the aquatic sampling program as regular lake sampling stations. Others are seasonal in nature and are examined on a periodic basis. A total of 12 springs and seeps in the Tract vicinity have been enumerated to date.

The twelve springs and seeps in the Piceance Basin were examined in March and July of 1975. Aquatic macroinvertebrates were collected from nine locations. Three locations were not sampled since their sources were diffuse and formed marshy areas without pools or well-defined channels. Temperature and dissolved oxygen data were also gathered in July. The majority of macroinvertebrates identified from springs are also identified from aquatic sampling stations.

II D-3 Terrestrial Vegetation Studies

Vegetation Mapping

A final vegetation map of Tract C-b has been completed at a scale of 1:12,000. Fifteen vegetation types have been recognized and depicted within the Tract boundaries.

Phytosociological Sampling

Phytosociological sampling has been conducted at both intensive study plots (1-0, 1-F to 6-0, 6-F) and additional vegetation stands (7 through 28). Tree-canopy cover estimates at the intensive study sites demonstrate the open character of the pinyon-juniper woodlands. Canopy cover ranges from 29-32 percent. Herb frequency data show that some species, such as western wheatgrass, are widespread, common and ecologically important. Most species occur sparingly and contribute little to total energy flow.

To evaluate how similar (or typical) the intensive study plots are additional vegetation stands have been compared to them by a similarity index calculation. The more similar the two stands are to each other the closer the index value approaches 1.0. The average similarity among all upland sagebrush sites was 0.74 while Stands 8 and 11 had a similarity of 0.905. In contrast average similarity among all stands of bottomland sagebrush was 0.845.

Pinyon-juniper woodlands on Tract C-b are much more variable than are the big sagebrush communities; therefore, similarity values are lower. The average similarity among all sample stands was 0.477. Maximum similarity occurred between plots 6-0 and 6-F (0.79). Chained sites are also less homogeneous than the sagebrush communities, and have an average similarity of 0.534. This heterogeneity results not only from original differences in the pinyon-juniper woodlands but also from disturbances caused by chaining operations.

Tree densities range from 65 to 105 trees per acre (160-259 trees per hectare). Composition of the woodlands varies from nearly 100 percent pinyon pine to sites where pine accounts for only 26 percent of the forest composition. The remaining composition is accounted for by Utah juniper and Rocky Mountain juniper.

Productivity Studies

Herbaceous production at intensive study plots was measured by monthly clippings of 0.1 m^2 quadrats. Peak production at most sites occurred in July except for Sites 4 and 6 whose peaks occurred in June and August, respectively. Estimates of shrub production were made on an individual shrub basis, and yearly production was measured as the difference between April and September standing crop estimates. The bottomland sagebrush communities are the most productive shrub communities within the study area. Shrub production in the upland sagebrush was much less than in the bottomland sagebrush. At the chained site shrub production was nearly as great as that at the upland sagebrush sites. Where sagebrush densities are high, total shrub production is also high. The lowest shrub production values were obtained from the pinyon-juniper woodlands. Shrub production here is one-fourth the production at the chained sites.

Decomposition and Litter Studies

Decomposition bags will be retrieved during December for analysis. Litter collected from valley and woodland sites is currently being dried. Litter collection in other communities has been discontinued because of the inefficiency of the collection method in these vegetation types. The low profile of the vegetation in the upland sagebrush and chained pinyon-juniper communities precludes the reliable collection of litter from important shrub species in these areas.

Successional Studies

The sampling and data analysis necessary for evaluation of the successional status of each of the plant communities has been completed and is included in the Annual Summary and Trends Report.

II D-4 Dendrochronology and Dendroclimatology

Studies involving dendrochronology and dendroclimatology were completed during the third quarter of the baseline study. The completed report is found in Quarterly Data Report #3, and no further reporting of this study will be made.

II D-5 Soils Survey

A soil survey for Tract C-b and the surrounding one-mile study area has been completed. This work has been accomplished through the cooperative efforts of the United States Soil Conservation Service (SCS), Woodward-Clyde Consultants, Agricultural Consultants Laboratories, Inc. (ACL) and C-b Shale Oil Project Environmental Sciences Staff. The work accomplished includes identification description mapping of soil-series units and their representative types (SCS); sampling and analysis of representative types for a suite of chemical and physical properties (Woodward-Clyde & ACL); and correlation of soils and vegetation (C-b Staff).

A detailed report on the findings of these combined studies is found in Quarterly Data Report #5 and the Annual Summary and Trends Report.

Seven soil series units were identified, described, mapped and analyzed. These series are identified in Chapter VI of the Annual Summary and Trends Report. The predominant soil series found (Rentsac channery) is a recent soil which has formed in place over relatively massive sandstone,parent materials. This soil dominates the upland ridge-and-valley topography of the study area. This fairly coarse soil alternates with soils of finer texture which also occur on the uplands. These include, in approximate order of importance, the Redcreek-Pentsac Complex, which is a recent soil formed over highly fractured sandstone, Forelle loam, which is formed over fractured sandstone and altered by wind-deposited materials, and Piceance loam, which is more shallow than the Forelle loam and is also formed over fractured sandstone altered by wind-deposited, finer material. Rentsac channery and the Redcreek-Rentsac Complex are associated with pinyon-juniper woodlands and chained rangelands. The Redcreek-Rentsac Complex is also found underlying upland sagebrush and bunchgrass sites. Forelle and Piceance loams are associated with upland sagebrush. Lowland soils have been formed from coarse alluvium of a mixed, sedimentary rock origin. These include Glendive loam, dominant in the narrower valleys and associated with big sagebrush stands, Hagga loam, which is associated with agricultural hay meadows found in the Piceance Creek Valley and Hanly loam, which occurs on alluvial fans and cones and is associated with greasewood stands and bottomland sagebrush sites.

All soils in the study area are cold and dry. None of the soils studied have high nutrient regimes. High concentrations of sodium and salts occur in two of the lowland soils (Glendive and Hanly loams). All soils are deficient in zinc, most are low in potassium and phosphorus. Nitrate levels are moderate as are the majority of trace elements. Most soils are moderately alkaline; bottomland soils are strongly alkaline.

A previous report on soil productivity (Quarterly Data Report #3) has provided data relating to support of vegetation. This information correlates with the nutrient analysis of soils conducted in this survey study in that both show upland sites to be more favorable to plant growth than bottomland sites.

II E GEOLOGY

SURFACE GEOLOGIC MAPPING PROGRAM

This study was conducted by Amuedo and Ivey. Its purposes were to:

1. Prepare a photogeologic map of lithologic units
2. Map the regional structure including position and orientation of faults
3. Prepare fracture analysis
4. Identify areas of unstable soil and rock
5. Locate unreported springs

Study Area

Centered on the C-b Tract the study area extends seven miles east-west and eight miles north-south at the widest points and covers 44 square miles (Figure II E-1). The study area is topographically part of Piceance Creek Basin, a major structural feature in the Colorado Plateau. It is transected by Piceance Creek which flows in a west-northwestward direction. Drainage and regional slope in the southern part of the area are to the north and northeast and in the northern one-third of the area the drainage and regional slope are to the south and southwest.

Piceance Creek and larger tributaries are incised into the regional surface with topographic relief near streams ranging from 300 feet to 500 feet. South of Piceance Creek the area is characterized by narrow, steep-walled, flat-bottomed valleys separated by broad interfluves whose flat-to-gently-rolling surfaces are inclined to the north. North of Piceance Creek the topography differs; although the major tributary valleys are steep-walled and flat-bottomed the interfluvial areas are dissected into narrow ridges and steep drainage ways.

Stratigraphy

Surface exposures of bedrock within the study area are Eocene sandstones and siltstones and unconsolidated Quaternary deposits. Eocene includes the sandstones and siltstones of the Uinta Formation and the four members of the Green River Formation which consists of dark shales, marlstones and thin-bedded sandstones, siltstones and limestones. Until recently the upper-most member of the Green River Formation (the Parachute Creek) was not recognized in surface outcroppings within the study area. Newly proposed changes in nomenclature and recently acquired

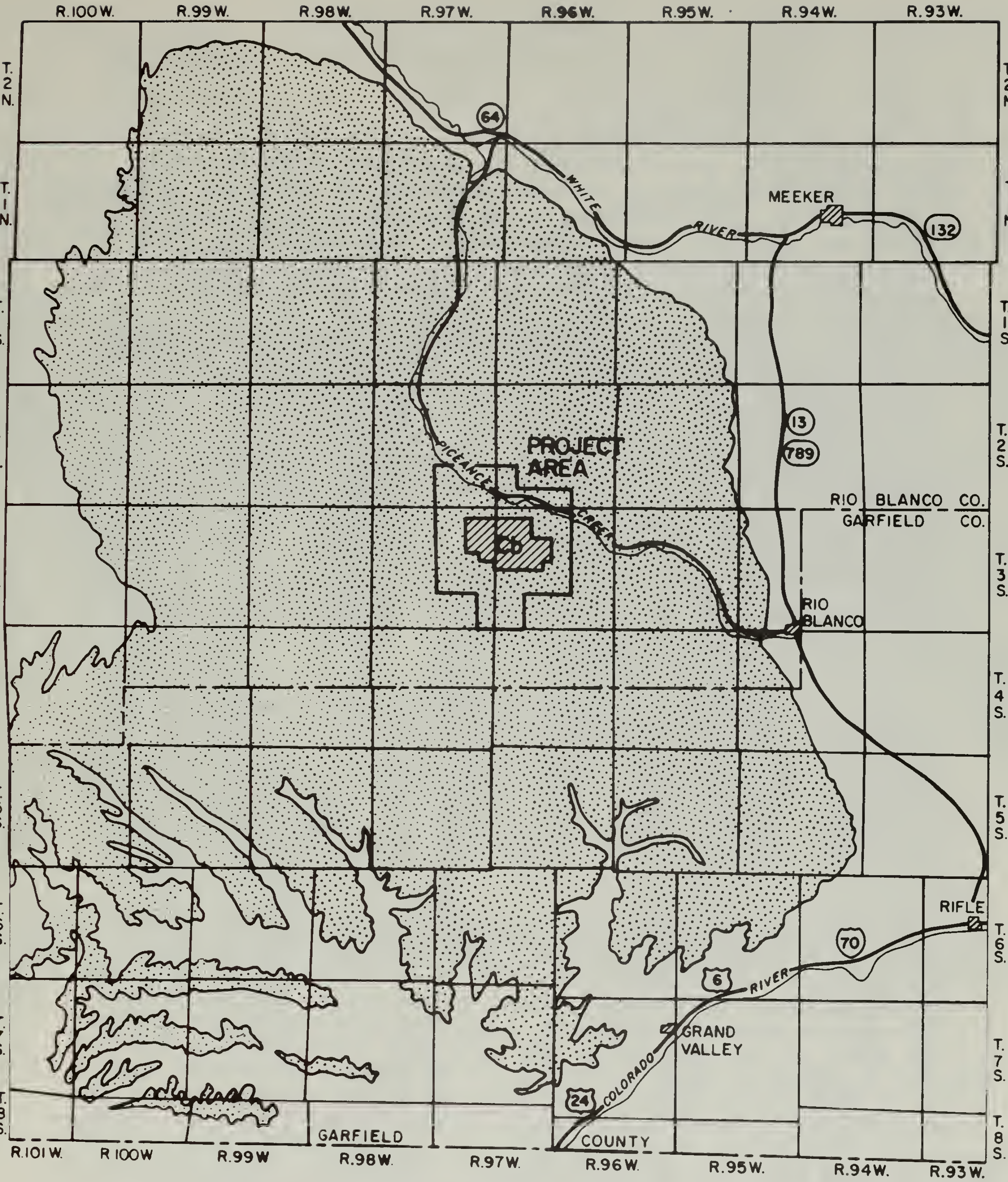


Figure II E-1

INDEX MAP
PICEANCE CREEK BASIN

knowledge regarding facies changes and the lateral extent of the marlstones of the Green River Formation allow the description of an outcropping of upper Green River (Parachute Creek) marlstone within the study area but not on the C-b Tract itself.

The contact between the Green River Formation and the overlying Uinta Formation is gradational with the marlstones of the Parachute Creek member interfingering with the sandstones and siltstones of the overlying Uinta. The sandstones of the Uinta Formation are thin-to-massive and quite lenticular. They exhibit rapid thickening, owing to channeling into underlying units, and rapid thinning and lateral pinchout. Being more resistant to weathering and erosional forces than the adjacent siltstones, they often form prominent outcroppings. Their lenticularity limits their usefulness as mapping units over the study area. However, ten possible mapping horizons were located on airphotos and subsequently located and described at the outcrop. Six mappable units were defined on the Tract itself (Figure II E-2) and one sandstone, Unit 5, was found to be persistent throughout the C-b Tract and thus useful as a surface mapping and correlative horizon. The unit was named the Scandard Gulch sandstone after the good exposures formed along the eastern side of Scandard Gulch. This yellow-brown, fine-to-medium-grained sandstone ranges in thickness from 30 to 40 feet. It is in part crossbedded and often is conglomeritic at the base. At the outcrop it commonly forms a cliff 4 to 15 feet high which cliff forms a rimrock that can be traced around the upland surface of the C-b Tract. At the base of this unit the cliff form of the sandstone gives way to the more gentle slope of the underlying siltstone, Unit 6.

A second sandstone, Unit 3, though unnamed was found to be a good mapping horizon in the southern part of the Tract. Unit 4, a siltstone forms the undulating upland surface of the Tract and overlies the Scandard Gulch sandstone. A secondary cliff form underlies Unit 6 and is exposed in the northern part of the Tract. It has been informally called the "Cannonball Sandstone" because of the many spherical concretions which have weathered out of it. Its base is not exposed within the project area.

Quaternary deposits were identified as stream alluvium, alluvial fans, colluvial deposits and mixed alluvium-colluvium. The stream alluvium forms the flat-bottomed floors of Piceance, Hunter and Willow Creeks and Stewart Gulch and is found to some extent up Scandard Gulch. Alluvial fan deposits occur where tributaries enter the larger valleys. The number of fans is large but the individual areal extent is quite small. Colluvial deposits occur on the uplands and the base of valley walls between alluvial fans. The alluvium-colluvium mapping unit covered areas where the depositional agent of unconsolidated deposits was unknown. Thick accumulations of alluvium-colluvium can be found in upland areas; where they occur in the upper reaches of the draws or on steep slopes, they are unstable particularly to the passage of large amounts of water.

Thirteen sections were measured during the course of the fieldwork using hand level and tape. Elevations were established from the U.S.G.S.

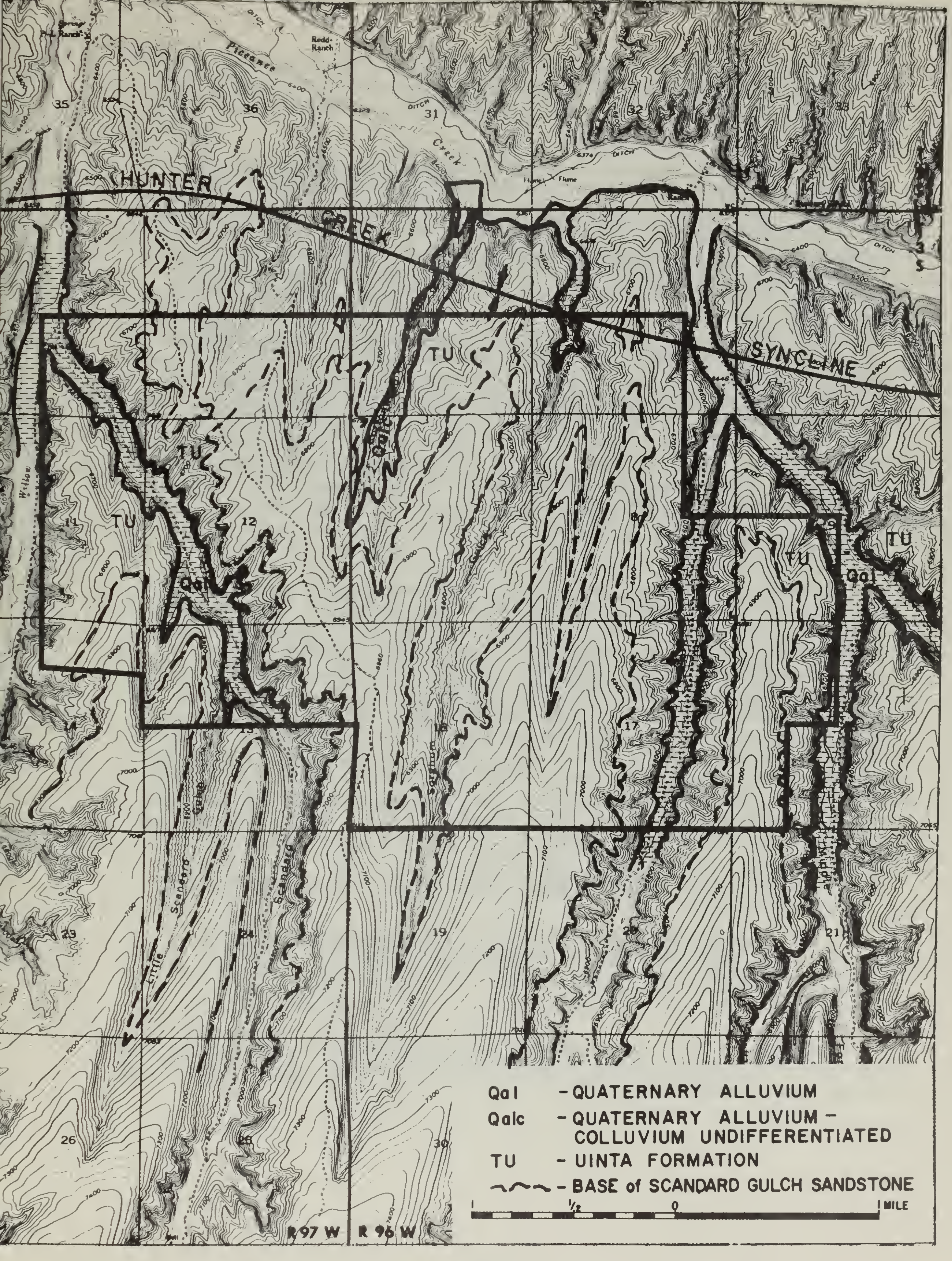


Figure II E-2. GENERALIZED SURFACE GEOLOGY

7-1/2 minute topographic maps and checked by a Thommen altimeter. Field sketches are shown in Quarterly Data Report #5.

Structure

The study area lies west of the structural axis of the Piceance Creek Basin as mapped on top of the Mahogany zone (Green River Formation) and on the south monoclinal limb of the Hunter's Creek Syncline which trends northwestward across the north edge of the area and lies south of Piceance Creek Dome. Dip on the flank of the dome is southward at low angles, 4-5 degrees. South of the axis of the Hunter's Creek Syncline, within the C-b Tract beds dip 1-2° to the northeast. Although major faults have been noted to the west and north of the study area only small faults were mapped within the area studied. These smaller faults, perhaps indicative of a more prominent subsurface structure, were mapped in Sections 8, 15, 16 and 17 of Township 3 South, Range 96 West. Most have reverse displacements ranging from two inches to four feet and are parallel to the primary jointing. They strike N 75° - 85° E and dip 55° - 75°N. In Middle Stewart Gulch and East Stewart Gulch faults were mapped that had three and four feet of displacement. Since these faults could not be correlated between drainages, it is supposed that they die-out laterally within 2000 feet.

Joints and Alignments

Joints and alignments were mapped from photos using such linear features as cliffs, vegetation lines and drainage lines. These linear features are believed to be related to jointing which appears to be of considerable length. Where measured, they could be traced for over 50 feet. One prominent joint system strikes N 72° W, dips vertically (±2°) and has an average density of two feet between joints. North of the C-b Tract and south of Hunter's Creek Syncline the primary joint system has about the same strike but the dip averages 60° to the northeast. North of the synclinal axis the trends are the same but the occurrence is more random. Measurements were made at 82 joint stations, 49 of which were on or within 600 feet of Tract C-b. The data were reduced and the study area was divided based on the joint trends and dip. These divisions and the most prominent joint trends are:

1. North of Piceance Creek--N 40° - 50° W (30%) and N 80° W to E-W (17%)

2. South of Piceance Creek--N 70° - 80° W (40%) and N 80° W to E-W (9%)

3. C-b Tract--N 70° - 80° W (25%), N 80° - E-W (24%).

The dips of the joint planes become progressively steeper approaching the C-b Tract from the north--from 35° north of Piceance Creek to vertical on the Tract itself.

Springs

The following are the springs located by field work and photo analysis. Flow rates were approximated. No springs were found on the C-b Tract.

Locations Along Willow Creek

Southeast quarter of the northeast quarter of sec. 22, T3S., R97W.

Seep flowing at intersection of old stream channel and present course. No flow rate determined. Field checked on 6/25/75.

Center of the southwest quarter of sec. 14, T3S., R97W.

Subsurface flow came to the surface. No flow calculated on 6/25/75. (Correlates with spring S-10) in the Surface Water section II A.

Center of the west half of sec. 35, T2S., R97W.

Intersection of Big Jimmy Gulch and Willow Creek. Uncalculated subsurface flow reached surface. Correlates with S-6 in section II A.

Center of the south half of the south half of sec. 11, T3S., R97W.

Numerous springs found along east bank of Hunter Creek over a distance of 520 feet. Flow was estimated at 40+ gpm on 6/25/75. (Correlates with S-9).

Locations Along West Stewart Gulch

Center, sec. 31, T3S., R96W.

Two springs flowed eight gpm on 6/17/75.

Southeast quarter of sec. 30, T3S., R96W.

Three springs found at Redd Cow Camp, no flows were recorded. Southernmost spring was a seep flow from west bank on 6/17/75. The "north" spring was underwater on this date.

Southwest quarter of sec. 20, T3S., R96W.

Two springs found and confirmed in late October, 1974.

Locations Along Stewart Gulch

Southwest quarter of the southwest quarter of sec. 4, T3S., R96W.

A spring flowing two gpm was located on 6/17/75 in a tributary drainage east of the road.

Southwest quarter of the southeast quarter of sec. 9, T3S., R96W.

Seep found near mouth of Middle Stewart Gulch. No measurable flow on 6/17/75. (Correlates with S-4).

Location in Cottonwood Gulch

Center of the southwest quarter of sec. 6, T3S., R96W.

A spring flowed two gpm on 6/25/75.

Other Location

Center of sec. 10, T3S., R96W.

A spring flowed one gpm on 6/18/75.

Environmental Geology

Relating, as it does, to the interaction between man and geology, environmental geology includes, as a subtopic, engineering geology. Thus the role of geology as it interacts with roads, power transmission lines, plant sites, crushers, reservoirs, waste disposal areas and other engineering works becomes important. In this regard the general engineering properties of the identified stratigraphic and lithologic units are presented in *Quarterly Data Report #5* (Table II E-1).

The Tract and its immediate vicinity have embankment material and an abundance of low-density rock. High density rock for use as rip-rap or aggregate is not available locally. If a batch plant is to be established, aggregate will have to be imported.

Geologic hazards such as landslides, rockfall, slump, soil creep and mud flow are generally absent from the Tract. The main potential for landsliding and slumping exists only if cuts are made in unconsolidated material.

A potential hazard from falling rock could be produced only with excavation of bedrock upslope from existing structures or exposures of fresh bedrock particularly if the bedrock face is oversteepened. Talus slopes could also develop in a similar environment particularly in platy siltstones and sandstones and where exposures of thin interbedded rocks occur.

The potential for flood damage does exist and would be related primarily to large-volume precipitation.

A large volume precipitation event would also produce erosion and consequent siltation problems. Sheet flow on all but the most shallow slopes would produce these same problems. These problems would likely be more severe in gulches and draws than in the alluvial filled valleys and more severe in the tributaries than in the Piceance Creek floodplain proper.

Paleontologic Sites and Archaeologic Artifacts

No archaeologic, prehistoric or historic finds were made during the field work. Plant and animal fossils of Eocene age were not uncommon. Most of the fossils found were carbonized fragments of leaves having no scientific value. A few quartzose sections of tree trunk were found. These do not show internal structure, are probably unidentifiable and of little paleobotanic significance.

Two small fossil bones were found in the southeast quarter of section 25, Township 3 South, Range 97 West. Both were only a few inches long and seemed to lack characteristics which would allow them to be identified. Another bone, found in the northeast quarter of section 24, Township 3 South, Range 97 West, was quite large and appeared to be a femur of a large mammal tentatively identified as Unitatherium (Dinoceras) mirable. The bone is of scientific interest in that finds of large Eocene mammals are uncommon in the Piceance Creek Basin. It has been placed in the Colorado University Museum at Boulder with the concurrence of both the Area Oil Shale Supervisor and the Bureau of Land Management.

Conclusions

1. The gross surface geology is relatively simple.

2. Major faulting is not present on the C-b Tract. Numerous minor reverse faults (displacement less than 4') were located on the southeast border of the Tract. They trend E-W and dip N.

3. The rock is well jointed with a nearly vertical primary joint set striking N 72°. This is the same trend as the horst and graben fault systems that terminate immediately north of the area.

4. Bedrock (coherent or consolidated rock) units mapped consist mainly of sandstones and siltstones with siltstones predominating. Lesser amounts of marlstone are present. Unconsolidated deposits include colluvium, alluvial fans, alluvium and colluvium-alluvium undifferentiated.

5. The areal extent of natural hazards is so small that they cannot be represented on the maps at the scale used. Soil creep and slump occur in areas at the heads of several tributaries along Willow Creek. Potential land stability problems will be confined mainly to artificial cuts.

6. Lithologic variations over short vertical and horizontal distances may cause corresponding variations in engineering characteristics.

7. Materials adequate for embankments are available in the area but high density rock for rip-rap and natural aggregates is not available in the area.

8. Detailed geologic mapping in the vicinity of the proposed shaft site confirmed that faults do not occur at the surface.

III

OTHER STUDIES

III A FISH AND WILDLIFE MANAGEMENT PLAN

During this quarter, a procedural Fish and Wildlife Management Plan has been completed. This Plan has been formulated through interaction with consultants who have been working on the Environmental Baseline Studies and through analysis of the data collected to date in those studies. It is anticipated that the Plan will continue to evolve as additional data are collected during the second year of baseline studies. The present Plan is contained in the Detailed Development Plan for Tract C-b and includes the following major topics:

1. Goals of the Plan. A statement of the goals of the Fish and Wildlife Management Plan which include meeting the requirements of the Oil Shale Lease Environmental Stipulations;

2. Scope of the Plan. General statements regarding the areal coverage of the Plan, phases covered, envisioned interaction with agencies involved in traditional management in the Piceance Basin area and procedures for cooperating with these agencies;

3. Existing Wildlife and Habitats. A section covering a general discussion of wildlife habitat types as they have been identified to date in the Tract area and wildlife species which have been identified in this area or could be expected to occur in the area. Ecological relationships such as the terrestrial food web, predator-prey relationships, migratory patterns of mule deer and raptors and determination of "important" species for the purposes of the Plan are also included;

4. Operational Setting. A section covering the planned location of facilities and planned scheduling of development activities. Also included are indications of specific types of impacts which might be expected to occur as a result of each type of activity planned for each phase of development; and

5. Implementation Plan. Concerned with the general strategy of the Plan, recommended design and specific problem areas. Included are definition of problems envisioned, timing of expected problems, proposed accomplishments with respect to minimizing the effects of these problems, details on strategies and tactics and performance standards. Types of specific problem areas include the following: significant modification of terrestrial habitats; erosion in

terrestrial habitats; modification of aquatic habitats; water pollution affecting aquatic habitats; reduction in groundwater discharge affecting terrestrial habitats; wildlife harassment resulting from extra vehicular and human activity and from activities of companion animals; impacts resulting from air pollution; impacts resulting from noise; vehicle-wildlife collisions; secondary impacts resulting from growth in human populations; personnel management; access management; and contingency planning problems.

III B REVEGETATION PROGRAM

The actions involving revegetation of areas disturbed during the exploration phase on Tract C-b, as outlined previously, were carried out in the fifth quarter.

Tables III B-1 and III B-2 are intended as informative summaries of the specific planting descriptions and plans which were implemented.

TABLE III B-1

SITE PLANTING DESCRIPTION	Air Quality-Met. Tower, Chained Pinyon-Juniper	A-1, Valley Bottom Sagebrush, near main turnoff on Piceance Creek Road	A-2, Valley Bottom Sagebrush, Pasture	A-3, Valley Bottom Sagebrush, in Scandard Gulch	A-4, Valley Bottom Sagebrush, head of Scandard Gulch	A-5, Valley Bottom Sagebrush, on Piceance Creek at mouth of Cottonwood Gulch	A-6/SC20, Valley Bottom Sagebrush, on Piceance Creek Road, big cut in hillside next to it	A-7/SC19, Valley Bottom Sagebrush, on Piceance Creek at mouth of Sorghum Gulch
Species	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre
Agropyran intermedium amur - Intermediate wheatgrass	2	3		3	3	2	2	2
Agropyran sibereum Siberian wheatgrass	2	3		3	3	3	3	3
Agropyron dasystachyum Thickspike wheatgrass	2							
Agropyron smithii rosano Western wheatgrass	2	3		3	3	2	2	2
Agropyron trachycaulum Slender wheatgrass	1							
Corocarpus montanus Mountain Mahogany	1/2							
Elymus cinereus Basin wildrye						1	1	1
Balsamorhiza sagittata Arrowleaf Balsam root	1/2	1/2		1/2	1/2	1/2	1/2	1/2
Oryzopsis hymedoides Indian ricegrass	1	1		1	1	1	1	1
Purshia tridentata Antelope bitterbrush	1/2	1/2		1/2	1/2	1	1	1
Stipa comata Green needlegrass	1	1		1	1	1/2	1/2	1/2
Symphoricarpus oreophilus Snowberry	1/2							
TOTAL	11-1/2	12	0	12	12	11	11	11

TABLE III B-1 Cont.

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SITE PLANTING DESCRIPTION	A-8, Valley Bottom sagebrush, Lower Stewart Gulch	A-9/SC8, Valley Bottom sagebrush, near Oldland Summer Camp	A-10/SC14, Valley Bottom sagebrush, Middle Stewart Gulch	A-11, Valley Bottom sagebrush, West Stewart, just past turnoff to ridge to met-tower	A-12, Valley Bottom sagebrush, Upper West Stewart Gulch	A-13, Valley Bottom sagebrush, in wash at head of Sorghum Gulch	Cb2, Chained Pinyon-Juniper ridge East of Cottonwood Gulch	Cb4, Chained Pinyon-Juniper ridge West of West Stewart Gulch
Species	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre
Agropyran intermedium amur - Intermediate wheatgrass	2	2	2	2	2	2	2	2
Agropyran sibereum Siberian wheatgrass	3	3	3	3	3	3	2	2
Agropyron dasystachyum Thickspike wheatgrass							2	2
Agropyron smithii rosano Western wheatgrass	2	2	2	2	2	2	2	2
Agropyron trachycaulum Slender wheatgrass							1	1
Corocarpus montanus Mountain Mahogany							1/2	1/2
Elymus cinereus Basin wildrye	1	1	1	1	1	1		
Balsamorhiza sagittata Arrowleaf Balsam root	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Oryzopsis hymedoides Indian ricegrass	1	1	1	1	1	1	1	1
Purshia tridentata Antelope bitterbrush	1	1	1	1	1	1		
Stipa comata Green needlegrass	1/2	1/2	1/2	1/2	1/2	1/2		
Symphoricarpus oreophilus Snowberry							1/2	1/2
TOTAL	11	11	11	11	11	11	11-1/2	11-1/2

TABLE III B-1 Cont.

SITE PLANTING DESCRIPTION	NQ4, Chained Pinyon-Juniper, ridge West of Scandard Gulch	NQ7/SC-7, Chained Pinyon-Juniper, ridge West of West Stewart Gulch	NQ12/SC12, Chained Pinyon-Juniper, ridge East of Sorghum Gulch	SG1, Valley Bottom Sagebrush, mouth of Scandard Gulch	SG2, Chained Pinyon-Juniper, ridge West of Cottonwood Gulch	SG3, Chained Pinyon-Juniper, ridge East of Sorghum Gulch	SG4, Chained Pinyon-Juniper, ridge between Scandard and Little Scandard Gulches	SG5, Chained Pinyon-Juniper West of support facility
Species	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre
Agropyran intermedium amur - Intermediate wheatgrass	2	2	2	3	2	2	2	2
Agropyran sibereum Siberian wheatgrass	2	2	2	3	2	2	2	2
Agropyron dasystachyum Thickspike wheatgrass	2	2	2		2	2	2	2
Agropyron smithii rosano Western wheatgrass	2	2	2	3	2	2	2	2
Agropyron trachycaulum Slender wheatgrass	1	1	1		1	1	1	1
Corocarpus montanus Mountain Mahogany	1/2	1/2	1/2		1/2	1/2	1/2	1/2
Elymus cinereus Basin wildrye								
Balsamorhiza sagittata Arrowleaf Balsam root	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Oryzopsis hymedoides Indian ricegrass	1	1	1	1	1	1	1	1
Purshia tridentata Antelope bitterbrush				1/2				
Stipa comata Green needlegrass				1				
Symphoricarpus oreophilus Snowberry	1/2	1/2	1/2		1/2	1/2	1/2	1/2
TOTAL	11-1/2	11-1/2	11-1/2	12	11-1/2	11-1/2	11-1/2	11-1/2

TABLE III B-1 Cont.

SITE PLANTING DESCRIPTION	SG6, Chained Pinyon-Juniper, ridge West of Sorghum Gulch	SG-7/NQ7, Chained Pinyon-Juniper, ridge West of West Stewart Gulch	SG8/A9, Valley Bottom Sagebrush, near Oldland Summer Camp	SG9, Chained Pinyon-Juniper, ridge above Scandard Gulch	SG10, Plateau sage/ Chained Pinyon-Juniper, near met.-tower	SG11, Chained Pinyon-Juniper, ridge East of Sorghum Gulch	SG12/NQ12, Chained Pinyon-Juniper, ridge East of Sorghum Gulch	SG13, Chained Pinyon-Juniper, lower ridge West of West Stewart Gulch
Species	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre
Agropyran intermedium amur - Intermediate wheatgrass	2	2	2	2	2	2	2	2
Agropyran sibereum Siberian wheatgrass	2	2	3	2	2	2	2	2
Agropyron dasystachyum Thickspike wheatgrass	2	2		4	4	4	4	4
Agropyron smithii rosano Western wheatgrass	2	2	2	1	1	1	1	1
Agropyron trachycaulum Slender wheatgrass	1	1						
Corocarpus montanus Mountain Mahogany	1/2	1/2		1/2	1/2	1/2	1/2	1/2
Elymus cinereus Basin wildrye			1					
Balsamorhiza sagittata Arrowleaf Balsam root	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Oryzopsis hymedoides Indian ricegrass	1	1	1	1	1	1	1	1
Purshia tridentata Antelope bitterbrush								
Stipa comata Green needlegrass			1/2					
Symphoricarpus oreophilus Snowberry	1/2	1/2		1/2	1/2	1/2	1/2	1/2
TOTAL	11-1/2	11-1/2	11	11-1/2	11-1/2	11-1/2	11-1/2	11-1/2

TABLE III B-1 Cont.

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SITE PLANTING DESCRIPTION	SG14/A10, Valley Bottom sagebrush, Middle Stewart Gulch	SG15, Chained Pinyon-Juniper, ridge between Scandard and Sorghum Gulches	SG16, Chained Pinyon-Juniper and Plateau Sage, site near Vegetation Plot #3	SG17, Pinyon-Juniper ridge between West Stewart and Middle Stewart Gulches	SG18, 18a, Plateau sagebrush, head of Sorghum Gulch	SG-19/A-7, Valley Bottom Sagebrush, on Piceance Creek at mouth of Sorghum Gulch	SG20/A-6, Valley Bottom Sagebrush, on Piceance Creek Pond, big cut in hill side next to it	SG21, Valley Bottom Sagebrush, Scandard Gulch
Species	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre	lbs./acre
Agropyran intermedium amur - Intermediate wheatgrass	2	2	2	2	2	2	2	3
Agropyran sibereum Siberian wheatgrass	3	2	2	2	2	3	3	3
Agropyron dasystachyum Thickspike wheatgrass	2	4	4	4	4	2	2	3
Agropyron smithii rosano Western wheatgrass		1	1		1			
Agropyron trachycaulum Slender wheatgrass				1				
Corocarpus montanus Mountain Mahogany		1/2	1/2		1/2			
Elymus cinereus Basin wildrye	1					1	1	
Balsamorhiza sagittata Arrowleaf Balsam root	1/2	1/2	1/2		1/2	1/2	1/2	1/2
Oryzopsis hymedoides Indian ricegrass	1	1	1	1	1	1	1	1
Purshia tridentata Antelope bitterbrush	1			1/2		1	1	1/2
Stipa comata Green needlegrass	1/2					1/2	1/2	1
Symphoricarpus oreophilus Snowberry		1/2	1/2	1/2	1/2			
TOTAL	11	11-1/2	11-1/2	11	11-1/2	11	11	12

TABLE III B-2

SITE PLANTING PLAN

Site Description and Location	Planting Date*	Seed Application	Seedbed Preparation	Mulching Treatment	Fertilizer	Fencing	Remarks
Air Quality Meteorological Tower, Chained Pinyon-Juniper	Nov. 3-6	broadcast	hand scarification	distribute slash	none	none	provide gravelled access to tower and instrument site
A-1, Valley Bottom Sage-Brush, near main turnoff on Piceance Creek Road	Nov. 3-6	drill	harrow lightly	none	none	none	favorable site for rehabilitation
A-2, Valley Bottom Sagebrush, pasture	------	------	none, leave as is	------	------	------	vegetation cover has been naturally established
A-3, Valley Bottom Sagebrush, in Scandard Gulch	Nov. 3-6	drill	harrow lightly	none	none	3 strand barbwire	less than 1/10 acre next to road, favorable site
A-4, Valley Bottom Sagebrush head of Scandard Gulch	Nov. 3-6	drill	harrow lightly	none	none	3 strand barbwire	favorable site,
A-5, Valley Bottom Sagebrush on Piceance Creek at mouth of Cottonwood Gulch	Nov. 3-6	drill	harrow lightly	none	none	none	favorable site, base of north slope
A-6/SG-20, Valley Bottom Sagebrush, on Piceance Creek Road, big cut in hill side next to it	Nov. 3-6	drill	harrow lightly	none	none	3 strand barbwire	favorable site, base of north slope
A-7/SG-19, Valley Bottom Sagebrush. on Piceance Creek at mouth of Sorghum Gulch	Nov. 3-6	drill	harrow lightly	none	none	3 strand barbwire	favorable site, base of north slope

TABLE III B-2 Cont.

SITE PLANTING PLAN

A-8, Valley Bottom, Sage brush, lower Stewart Gulch	Nov. 3-6	drill	harrow lightly	none	none	none	favorable site
A-9/SG-8, Valley Bottom Sagebrush, near Oldland Summer Camp	Nov. 3-6	drill	harrow lightly pit needs cover and litter cleanup	------	------	already in fenced area	area could also be smoothed when pit is covered up - additional disturbance expected
A-10/SG-14, Valley Bottom Sagebrush, middle Stewart Gulch	Nov. 3-6	drill	harrow lightly	none	none	3 strand barbwire	5 foot cut on west side may require broadcast seeding and mulch excelsior
A-11, Valley Bottom Sagebrush West Stewart just past turnoff to ridge met. tower	Nov. 3-6	drill	harrow lightly	none	none	3 strand barbwire	favorable site
A-12, Valley Bottom Sagebrush, Upper West Stewart Gulch	Nov. 3-6	drill	harrow lightly	none	none	3 strand barbwire	favorable site
A-13, Valley Bottom Sagebrush in wash at head of Sorghum Gulch	Nov. 3-6	drill with some broadcasting	harrow lightly	none	none	none	favorable site, small area about 20 to 50 feet
C-b2, Chained Pinyon-Juniper ridge east of Cottonwood Gulch	Nov. 3-6	broadcast	pad requires minimal roughing; no recontouring is necessary	none	none	none	this site shows voluntary establishment of permanent vegetation
C-b4, Chained Pinyon-Juniper ridge west of Stewart Gulch	Nov. 3-6	broadcast and drill	minor ripping and scarification, recontour	none	none	none	------

TABLE III B-2 Cont.

SITE PLANTING PLAN

NQ4, Chained Pinyon-Juniper ridge West of Scandard Gulch	Nov. 3-6	broadcast	lightly harrow after recontouring	none	less than 80 lbs. available N.P.K./acre in summer of 1976	none	include roadway; water bars needed on roadway site
NQ7/SG-7, Chained Pinyon-Juniper, ridge West of West Stewart Gulch	Nov. 3-6	broadcast	rip and cover with available fine material	replace slash	none	none	------
NQ12-SG12, Chained Pinyon-Juniper, ridge East of Sorghum Gulch	Nov. 3-6	broadcast	recontour pad; rough and distribute slash	none	none	none	no monitoring access required; some device needed to prevent vehicular traffic
SG1, Valley Bottom Sagebrush, mouth of Scandard Gulch	Nov. 3-6	drill	(pad has been prepared)	none	none	3 strand barbwire	access for well monitoring required
SG2, Chained Pinyon-Juniper ridge west of Cottonwood Gulch	Nov. 3-6	broadcast	recontouring followed by light harrowing	straw or excelsior on cat area	less than 80 lbs. available N.P.K./acre in summer of 1976	none	cut slope requires broadcasting and mulching
SG3, Chained Pinyon-Juniper, ridge East of Sorghum Gulch	Nov. 3-6	broadcast	harrow lightly	none	less than 80 lbs. available N.P.K./acre in summer of 1976	none	------
SG4, Chained Pinyon-Juniper ridge between Scandard and Little Scandard Gulches	Nov. 3-6	broadcast	harrow lightly	none	less than 80 lbs. available N.P.K./acre in summer of 1976	none	------

TABLE III B-2 Cont.

SITE PLANTING PLAN

SG11, Chained Pinyon-Juniper, ridge East of Sorghum Gulch	Nov. 3-6	broadcast	harrow lightly	none	less than 80 lbs. available N.P.K./acre in summer of 1976	none	------
SG12/NQ12, Chained Pinyon-Juniper ridge East of Sorghum Gulch	Nov. 3-6	broadcast	recontour pad; rough and distribute slash	none	none	none	no monitoring access required; some device needed to prevent vehicular traffic
SG13, Chained Pinyon-Juniper lower ridge West of West Stewart Gulch	Nov. 3-6	broadcast	light harrowing; restore contour	none	none	none	------
SG14/A-10, Valley Bottom Sagebrush, Middle Stewart Gulch	Nov. 3-6	drill	harrow lightly	none	none	3 strand barbwire	5 foot cut on West side may require broadcast seeding and mulch exelsior
SG15, Chained Pinyon-Juniper, ridge between Scandard and Sorghum Gulches	Nov. 3-6	broadcast	rip surface recontour pad; pull back toe of pad; replace fine material stockpiled; distribute slash	------	none	none	include several shrub species as transplants as follow-up
SG16, Chained Pinyon Juniper and Plateau sage , site near Vegetation Plot #3	Nov. 3-6	drill and broadcast	minimal roughing and harrow; toe of pad should be pulled back	------	none	none	place water bars adjacent to drainings to disperse runoff onto pad; plans include access roadway
SG17, Pinyon-Juniper, ridge between West Stewart and Middle Stewart Gulches	Nov. 3-6	broadcast	rip surface; replace debris and fine material	none	none	none	allow access through pad/shrub sod; Pinyon and Juniper set outs as follow-up

TABLE III B-2 Cont.

SITE PLANTING PLAN

SG5, Chained Pinyon-Juniper West of Support Facility	Nov. 3-6	broadcast	light harrowing following recontouring	possibly on 6 foot cut	less than 80 lbs. available N.P.K./acre in summer of 1976	none	------
SG6, Chained Pinyon-Juniper ridge West of Sorghum Gulch	Nov. 3-6	broadcast	Fine material on edges of bed should be pulled back on pad. Slash should be spread on pad. Minimal roughing with harrow; no contouring.	------	none	none	retain gravel access to monitoring shed
SG7/NQ7, Chained Pinyon-Juniper, ridge West of West Stewart Gulch	Nov. 3-6	broadcast	rip and cover with available fine material	replace slash	none	none	------
SG8/A-9, Valley Bottom Sagebrush, near Oldland Summer Camp	Nov. 3-6	drill	harrow lightly. Pit needs covering and litter cleaned up.	------	------	already in fenced-in area	area could also be smoothed when the pit is covered up
SG9, Chained Pinyon-Juniper, ridge above Scandard Gulch	Nov. 3-6	broadcast	harrow lightly	none	less than 80 lbs. available N.P.K./acre in summer of 1976	none	------
SG10, Plateau Sage/Chained Pinyon-Juniper, near met. tower	Nov. 3-6	broadcast and drill	pad needs minimal roughing and pipe harrow	none	none	none	maintain monitoring access

TABLE III B-2 Cont.

SITE PLANTING PLAN

SG18a, Plateau Sagebrush, head of Sorghum Gulch	Nov. 3-6	drill and broadcast	pad has been ripped and recontoured	none	none	3 strand barbwire	must allow access for monitoring and through pad
SG19/A-7, Valley Bottom Sagebrush, on Piceance Creek at mouth of Sorghum Gulch	Nov. 3-6	drill	harrow lightly	none	none	3 strand barbwire	favorable site, base of north slope
SG20/A-6, Valley Bottom Sagebrush, on Piceance Creek Road, big cut in hill side next to it	Nov. 3-6	drill	harrow lightly	none	none	3 strand barbwire	favorable site; base of north slope
SG21, Valley Bottom Sagebrush, Scandard Gulch	Nov. 3-6	drill and broadcast	(seedbed has been roughed) terrace slopes above and below roadway	none	none	3 strand barbwire	fence pad on either side of road; plant shrub species on lower slope terraces

*The planting date for three species: Balsam foot, Snowberry and Thickspike wheatgrass will be before March 30, 1976, weather permitting.

III C MICROENVIRONMENTAL STUDIES

The results of preliminary analysis of microenvironmental data collected on Tract C-b during the months from March, 1975 to August, 1975 have been presented in Quarterly Data Report #5. These data represent the initial deliniation of the major plant community types found in the study area in terms of physical characteristics. In these first analyses three parameters have been emphasized: 1) precipitation; 2) soil moisture; and 3) temperature.

Precipitation shows no apparent trends or patterns in terms of vegetation type but instead is distributed quite sporadically over the Tract and surrounding study area. The importance of precipitation is currently seen in a regional sense and is otherwise being treated through soil field capacity and permeability.

Soil moisture data indicate some patterns relative to vegetation type. Upland sagebrush sites remain more moist throughout the growing season. Bottomland sagebrush sites are the driest, tending toward stable dry conditions early in the growing season. Woodlands and chained rangelands are intermediate in soil moisture values. The soil moisture data also reflect seasonal relationships. Soil moisture is highest in the early spring, tending toward progressively drier conditions throughout the summer with periodic increases during periods of rainfall. Moisture levels increase during the fall.

Temperature profiles constructed from readings obtained at several soil, surface and free air levels provide good deliniation of the major vegetation types. In general, pinyon-juniper woodlands tend to be the coldest sites. This condition is the apparent result of lower insolation due to canopy cover. Chained pinyon-juniper rangelands are the warmest sites. Upland sagebrush and bottomland sagebrush sites are intermediate with respect to mean temperatures. Records from bottomland sagebrush sites show the influence of cold air drainage which occurs in the valley bottoms. Upland sagebrush sites show the effects of a low vegetation profile and high solar insolation.

These three parameters have been emphasized because of their generally accepted influence on vegetation and other living systems. Future analysis will incorporate the influence of these as well as other parameters.

Also included in this report (Table III C-1 and III C-2) are summaries of data collected during July and August.

Table III C-1

MICROENVIRONMENTAL STATIONS

MONTHLY SUMMARY

JULY

STATION NUMBER	SOIL TEMPERATURE °C			AIR TEMPERATURE °C					SOIL MOISTURE %			PRECIPITATION, Total cm*	RELATIVE HUMIDITY, %	WIND SPEED MPH		WIND DIRECTION °Azimuth		NET SOLAR RADIATION, Langleys	VEGETATION TYPE AND LOCATION
	-60 cm	-40 cm	-20 cm	0 cm	1 meter	3 meters	Minimum, Absolute	Maximum, Absolute	-60 cm	-40 cm	-20 cm			1 meter	3 meters	1 meter	3 meters		
1	▨	▨	26.5	▨	▨	▨	-3.0	40.0	▨	▨	44	1.8	18	▨	▨	▨	▨	▨	CHAINED PINYON-JUNIPER RANGELAND (Vegetation Plot #1)
2	▨	▨	19.3	▨	▨	▨	-5.0	43.0	▨	▨	35	1.8	65	▨	▨	▨	▨	▨	CHAINED PINYON-JUNIPER RANGELAND (Vegetation Plot #2)
3@	19.8	()	21.7	24.5	20.6	▨	-11.0	21.0	58	63	37	0.6	48	4.3	▨	96	▨	▨	UPLAND SAGEBRUSH (Vegetation Plot #3)
4@	()	()	()	()	()	▨	-6.0	45.0	40	41	()	2.5	69	()	▨	()	▨	▨	BOTTOM LAND SAGEBRUSH (Vegetation Plot #4)
5	▨	▨	4.8	▨	▨	▨	0.0	40.0	▨	▨	33	1.3	28	▨	▨	▨	▨	▨	PINYON-JUNIPER WOODLAND (Vegetation Plot #5)
6@	12.4	13.5	14.6	19.3	15.0	▨	1.0	39.0	58	62	50	2.4	35	0.8	▨	137	▨	▨	PINYON-JUNIPER WOODLAND (Vegetation Plot #6)
7@	()	16.7	28.0	22.5	19.4	()	4.1	52.7	66	60	37	4.6	31	1.49	()	172	()	.81	CHAINED PINYON-JUNIPER RANGELAND (Animal Trapping Grid #1)
8	▨	▨	24.5	▨	▨	▨	6.0	47.0	▨	()	31	3.2	52	▨	▨	▨	▨	▨	BUNCHGRASS COMMUNITY (South-Facing Slope)
9	▨	▨	27.0	▨	▨	▨	-4.0	46.0	25	23	21	1.0	55	▨	▨	▨	▨	▨	BOTTOM LAND SAGEBRUSH (Mouth of Sorghum Gulch)
10	▨	▨	24.0	▨	▨	▨	()	()	29	26	21	()	69	▨	▨	▨	▨	▨	RABBITBRUSH COMMUNITY (Mouth of West Stewart Gulch)
11	▨	▨	18.5	▨	▨	▨	()	()	▨	▨	24	()	34	▨	▨	▨	▨	▨	BUNCHGRASS COMMUNITY (West-Facing Talus Slope)
12	▨	▨	18.0	▨	▨	▨	()	()	42	36	28	()	29	▨	▨	▨	▨	▨	BOTTOM LAND SAGEBRUSH (Alluvial Site)
13	▨	▨	24.0	▨	▨	▨	-1.0	39.0	()	()	45	3.4	30	▨	▨	▨	▨	▨	MIXED MOUNTAIN SHRUBLAND (North-Facing Slope)
14	▨	▨	27.5	▨	▨	▨	-1.0	39.0	41	44	35	()	31	▨	▨	▨	▨	▨	PINYON-JUNIPER WOODLAND (West-Facing Slope)
15	▨	▨	17.0	▨	▨	▨	-3.0	44.0	▨	45	33	2.1	55	▨	▨	▨	▨	▨	PINYON-JUNIPER WOODLAND (Cottonwood Gulch)
16	▨	▨	27.0	▨	▨	▨	()	()	59	48	35	3.0	60	▨	▨	▨	▨	▨	UPLAND SAGEBRUSH (Head of Sorghum Gulch)
17	▨	▨	27.0	▨	▨	▨	()	()	52	32	46	()	40	▨	▨	▨	▨	▨	ANNUAL WEED COMMUNITY (Abandoned Drill Pad)

@ Continuous Recording Stations

* Precipitation Values Are Totals For Period, Minimum And Maximum Temperature Values Are Absolute; All Other Values Are Expressed As Means

▨ Values Not Measured At These Stations

() Values Not Available For This Period Due To Instrument Failure

Table III C-2

MICROENVIRONMENTAL STATIONS

MONTHLY SUMMARY

August

STATION NUMBER	SOIL TEMPERATURE °C			AIR TEMPERATURE °C					SOIL MOISTURE %			PRECIPITATION, Total cm*	RELATIVE HUMIDITY, %	WIND SPEED MPH		WIND DIRECTION °Azimuth		NET SOLAR RADIATION, Langleys	VEGETATION TYPE AND LOCATION
	-60 cm	-40 cm	-20 cm	0 cm	1 meter	3 meters	Minimum, Absolute	Maximum, Absolute	-60 cm	-40 cm	-20 cm			1 meter	3 meters	1 meter	3 meters		
1	▨	▨	()	▨	▨	▨	1.0	42.0	▨	▨	35	1.0	43	▨	▨	▨	▨	▨	CHAINED PINYON-JUNIPER RANGELAND (Vegetation Plot #1)
2	▨	▨	()	▨	▨	▨	1.0	44.0	▨	▨	28	0.8	95	▨	▨	▨	▨	▨	CHAINED PINYON-JUNIPER RANGELAND (Vegetation Plot #2)
3@	21.2	()	22.3	24.8	21.7	▨	1.0	26.0	42	49	36	0.4	31	4.10	▨	170	▨	▨	UPLAND SAGEBRUSH (Vegetation Plot #3)
4@	17.2	17.9	19.1	20.2	16.3	▨	-1.0	48.0	29	29	()	1.0	96	1.15	▨	147	▨	▨	BOTTOM LAND SAGEBRUSH (Vegetation Plot #4)
5	▨	▨		▨	▨	▨	4.0	32	▨	▨	26	1.1	46	▨	▨	▨	▨	▨	PINYON-JUNIPER WOODLAND (Vegetation Plot #5)
6@	14.5	15.3	16.4	22.2	16.4	▨	9.0	35.0	43	45	43	0.7	91	0.64	▨	152	▨	▨	PINYON-JUNIPER WOODLAND (Vegetation Plot #6)
7@	()	17.1	18.4	20.6	17.0	()	1.0	52.0	63	53	40	0.4	24	1.54	()	195	()	1.12	CHAINED PINYON-JUNIPER RANGELAND (Animal Trapping Grid #1)
8	▨	▨	()	▨	▨	▨	()	()	▨	21	18	()	98	▨	▨	▨	▨	▨	BUNCHGRASS COMMUNITY (South-Facing Slope)
9	▨	▨	()	▨	▨	▨	0.0	39.0	21	21	()	3.4	91	▨	▨	▨	▨	▨	BOTTOM LAND SAGEBRUSH (Mouth of Sorghum Gulch)
10	▨	▨	()	▨	▨	▨	-1.0	38.0	26	25	22	1.8	87	▨	▨	▨	▨	▨	RABBITBRUSH COMMUNITY (Mouth of West Stewart Gulch)
11	▨	▨	()	▨	▨	▨	()	()	▨	▨	23	()	89	▨	▨	▨	▨	▨	BUNCHGRASS COMMUNITY (West-Facing Talus Slope)
12	▨	▨	12.0	▨	▨	▨	0.0	41.0	28	25	24	1.8	89	▨	▨	▨	▨	▨	BOTTOM LAND SAGEBRUSH (Alluvial Site)
13	▨	▨	()	▨	▨	▨	6.0	38.0	()	()	37	4.3	91	▨	▨	▨	▨	▨	MIXED MOUNTAIN SHRUBLAND (North-Facing Slope)
14	▨	▨	()	▨	▨	▨	4.0	40.0	33	37	32	1.0	34	▨	▨	▨	▨	▨	PINYON-JUNIPER WOODLAND (West-Facing Slope)
15	▨	▨	()	▨	▨	▨	3.0	41.0	▨	33	19	2.8	94	▨	▨	▨	▨	▨	PINYON-JUNIPER WOODLAND (Cottonwood Gulch)
16	▨	▨	()	▨	▨	▨	3.0	41.0	37	35	33	1.5	89	▨	▨	▨	▨	▨	UPLAND SAGEBRUSH (Head of Sorghum Gulch)
17	▨	▨	()	▨	▨	▨	()	()	30	27	25	()	()	▨	▨	▨	▨	▨	ANNUAL WEED COMMUNITY (Abandoned Drill Pad)

@ Continuous Recording Stations
* Precipitation Values Are Totals For Period, Minimum And Maximum Temperature Values Are Absolute; All Other Values Are Expressed As Means
▨ Values Not Measured At These Stations
() Values Not Available For This Period Due To Instrument Failure

III D AERIAL PHOTOGRAPHIC PROGRAM

No additional information has been produced from this program since the Quarterly Summary Report #4.

III E ARCHAEOLOGICAL STUDIES

The final report can be found in Quarterly Data Report #2. No additional work has been done.

III F SCENIC VALUES PROGRAM

The final report on this program was presented in Quarterly Data Report #4.

Form 1279–3
(June 1984)

BORROWER'S

TN 859 .C64 C3747 no
C-b Shale Oil Projec
Tract C-b: summary r

DATE LOANED	BORROWER

USDI – BLM